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FIFTY-FIFTH YEAR OF CONTINUOUS PUBLICATION

June 1946

VOLUME LXXI NUMBER 6

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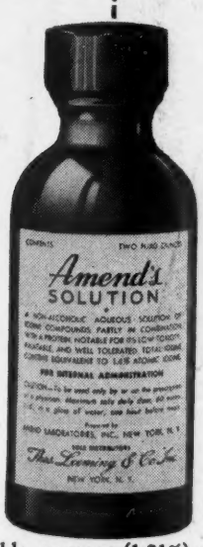

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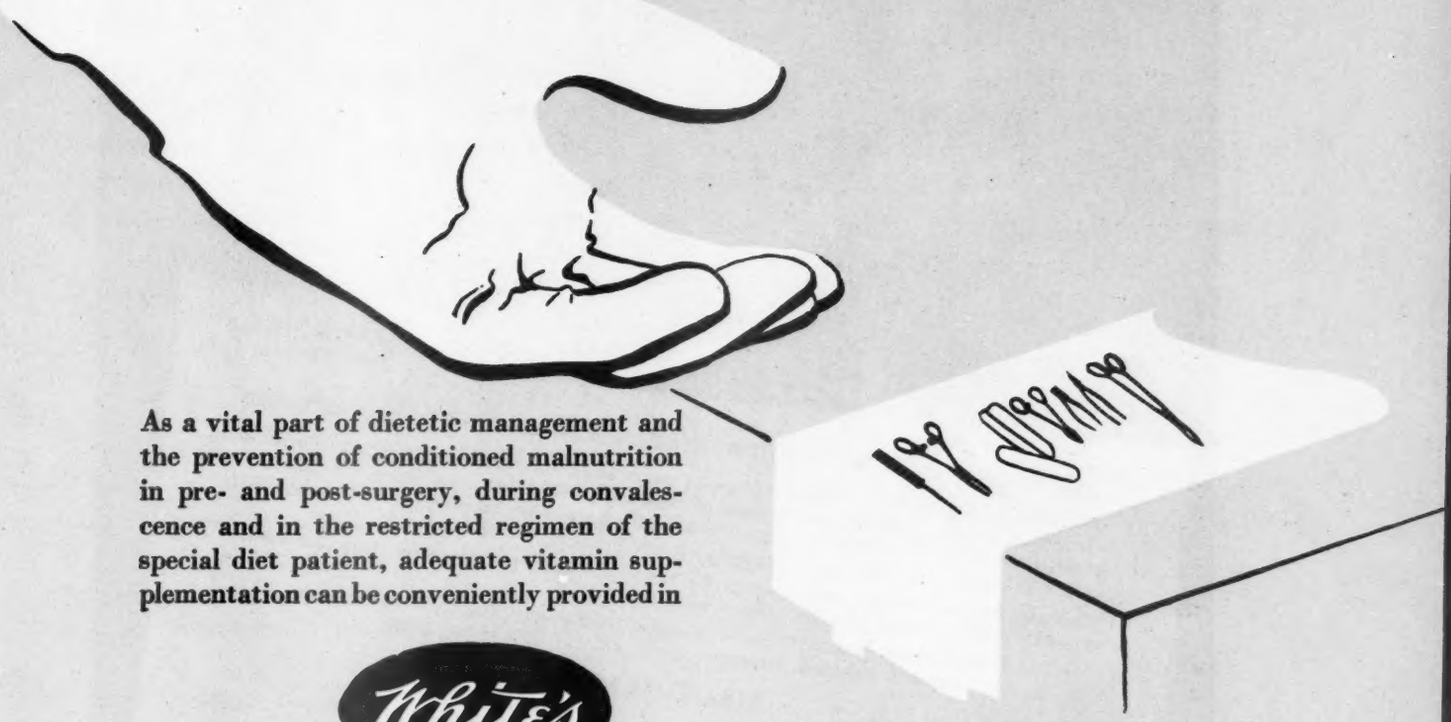

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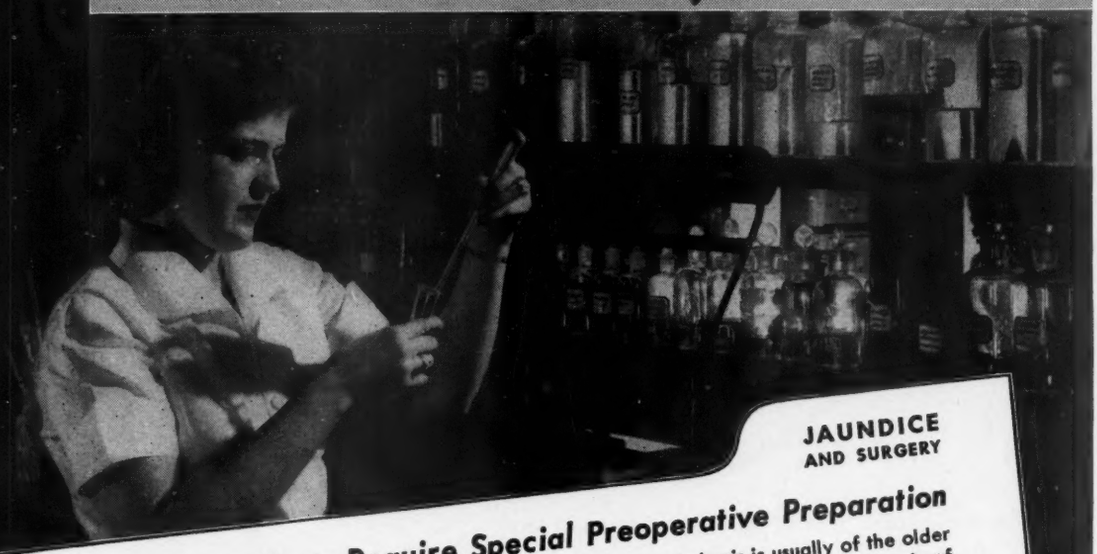

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*Meyer, K. A.: Surgical Considerations in Jaundice. Southwestern Med., 26: 35-38 (Feb.), 1942.

**Byrne, R. V.: Surgical Jaundice. Western J. Surg., 48: 370-373 (June), 1940.

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3. Illingworth, C. F. W.: Recent Developments in Surgery of Obstructive Jaundice, with Special Reference to the Risk of Hemorrhage. Edinburgh M. J., 46: 762-780 (Dec.), 1939.
4. McGarty, M. A.: Jaundice and Its Surgical Aspects: Care of the Jaundiced Patient Preoperatively and Postoperatively. Wisconsin M. J., 43: 1043-1047 (Oct.), 1944.
5. McLaughlin, C. W., Sharpe, J. C., and Cunningham, R.: Surgical Aspects of Familial Hemolytic Jaundice. Internat. Clinics, 4: 108-125 (Dec.), 1941.
6. Rhoads, J. E., and Ravdin, I. S.: Control of Hemorrhage in Patients Operated on for Obstructive Jaundice. Rev. Gastro-enterology, 7: 169-176 (March-April), 1940.

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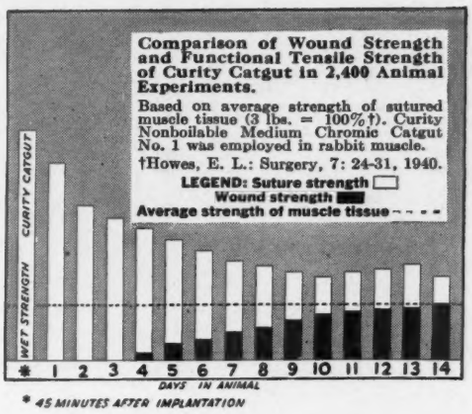
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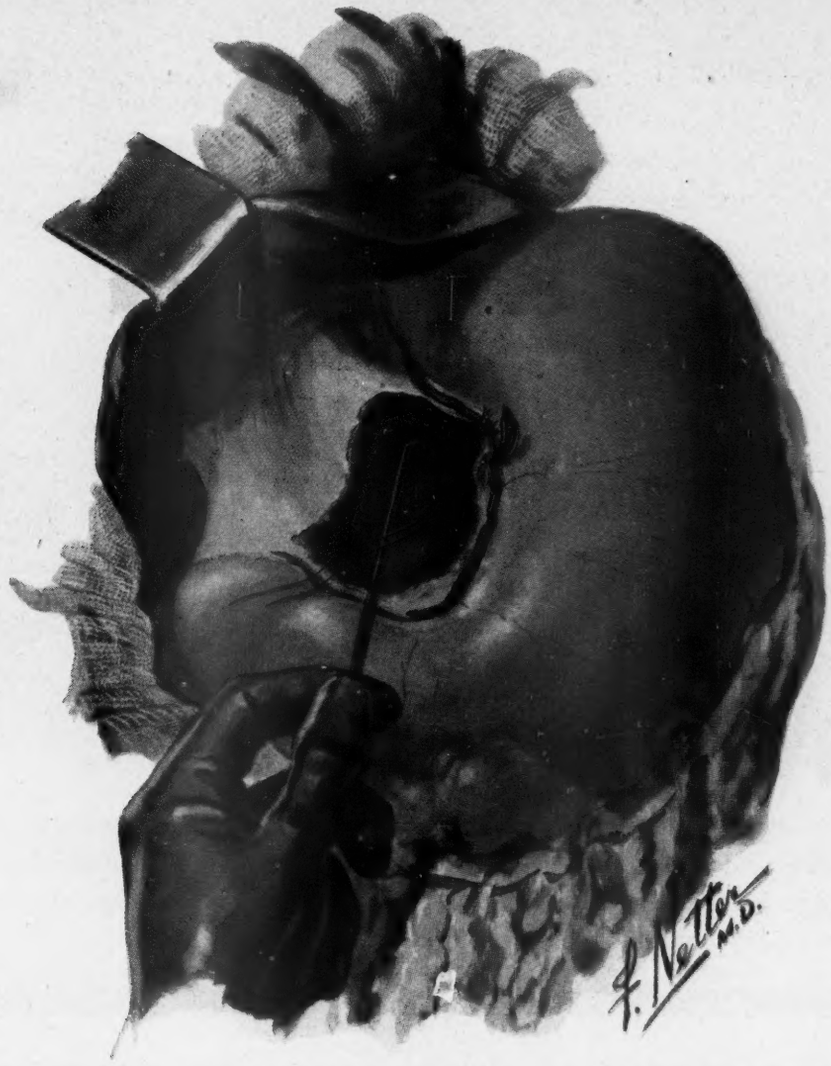

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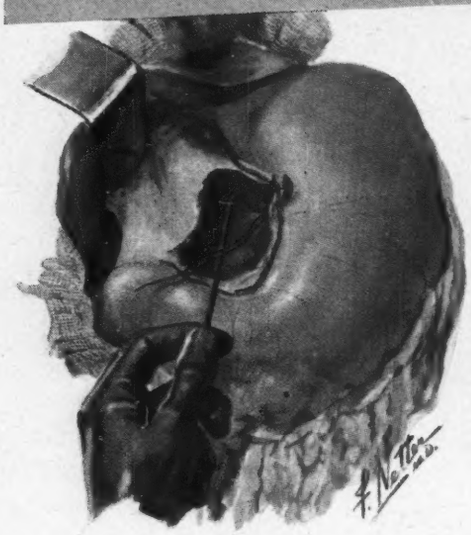
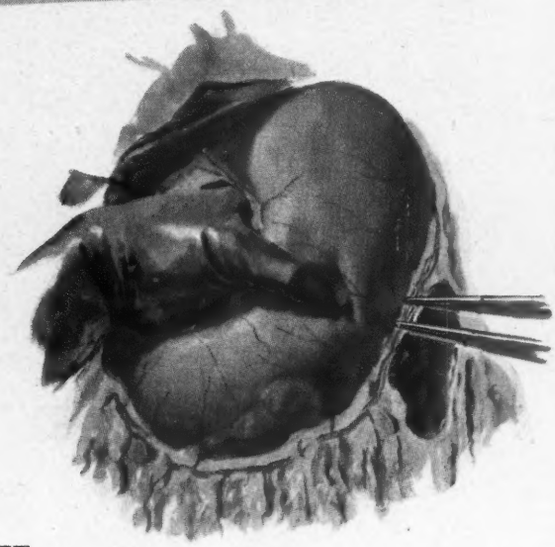
Partial Gastrectomy

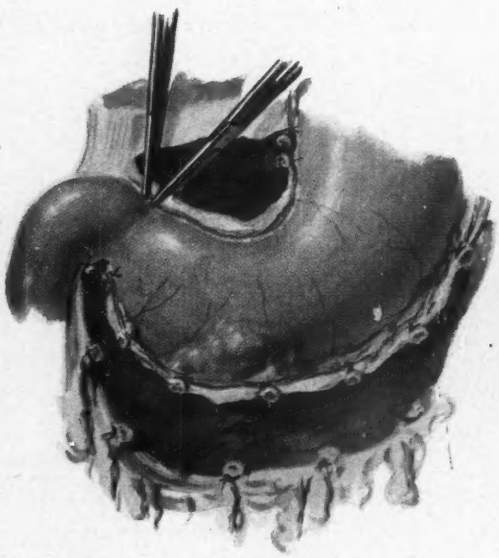
The remainder of this operation, comprising closure of the duodenal stump and gastro-jejunal anastomosis, will appear in a later issue.



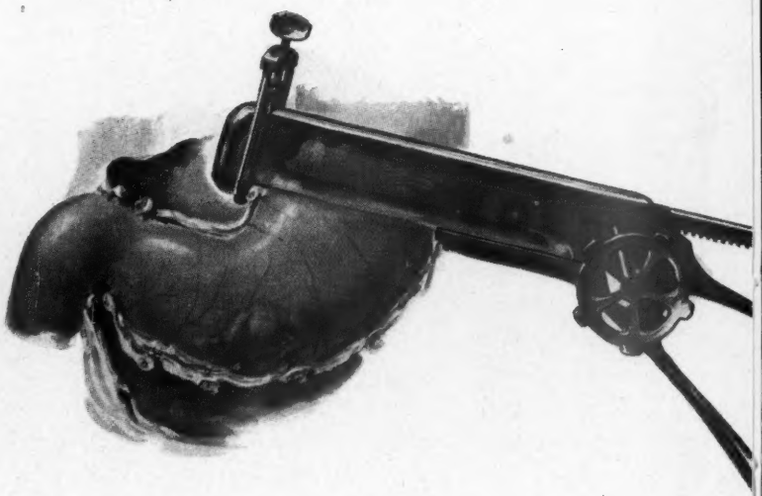
I. Stomach drawn out through extensive mid-line incision. Opening made in gastro-hepatic omentum; left gastric vessels ligated doubly above, singly below point of division.



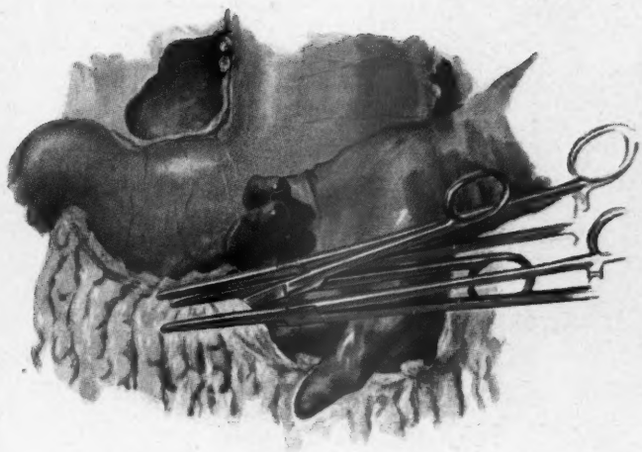
II. Opening made in gastro-colic omentum. Clamps applied to left gastro-epiploic vessels—tip of clamps at stomach edge. Vessels are next cut and ligated.



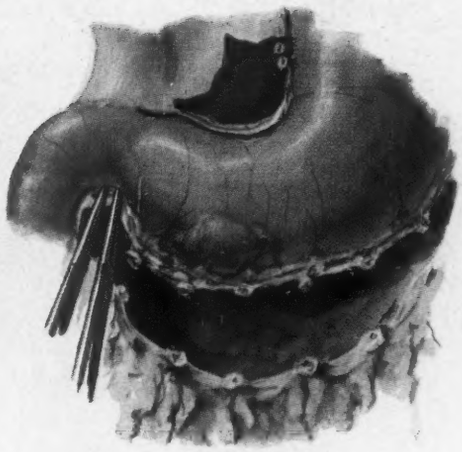
V. Right *gastric* vessels clamped—tip of clamps at edge of duodenum. Vessels are next cut and ligated.



VI. De Petz clamp applied at line of proposed gastric section.

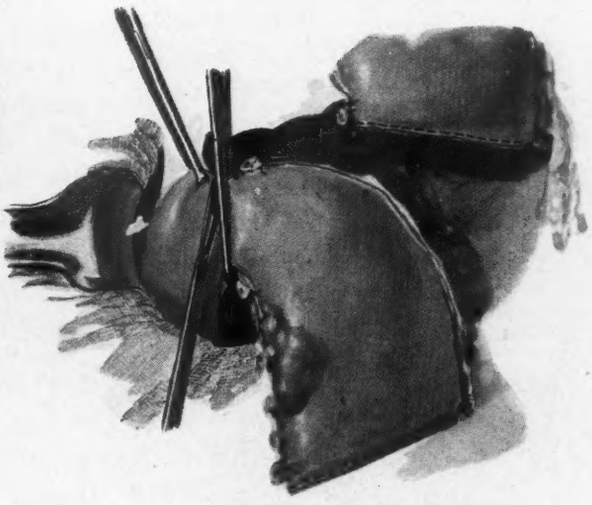


III. Gastro-colic omentum divided between clamps, taking care to avoid injuring the middle colic vessels in the underlying mesocolon.



IV. Right gastro-epiploic vessels clamped—tip of clamps at edge of duodenum. Vessels are next cut and ligated.

VII. Stomach divided between the rows of clips and turned down. Duodenum being freed from pancreas sufficiently to allow later closure of duodenal stump.



VIII. Duodenum held up by Allis clamp. Pylorus clamped and divided.

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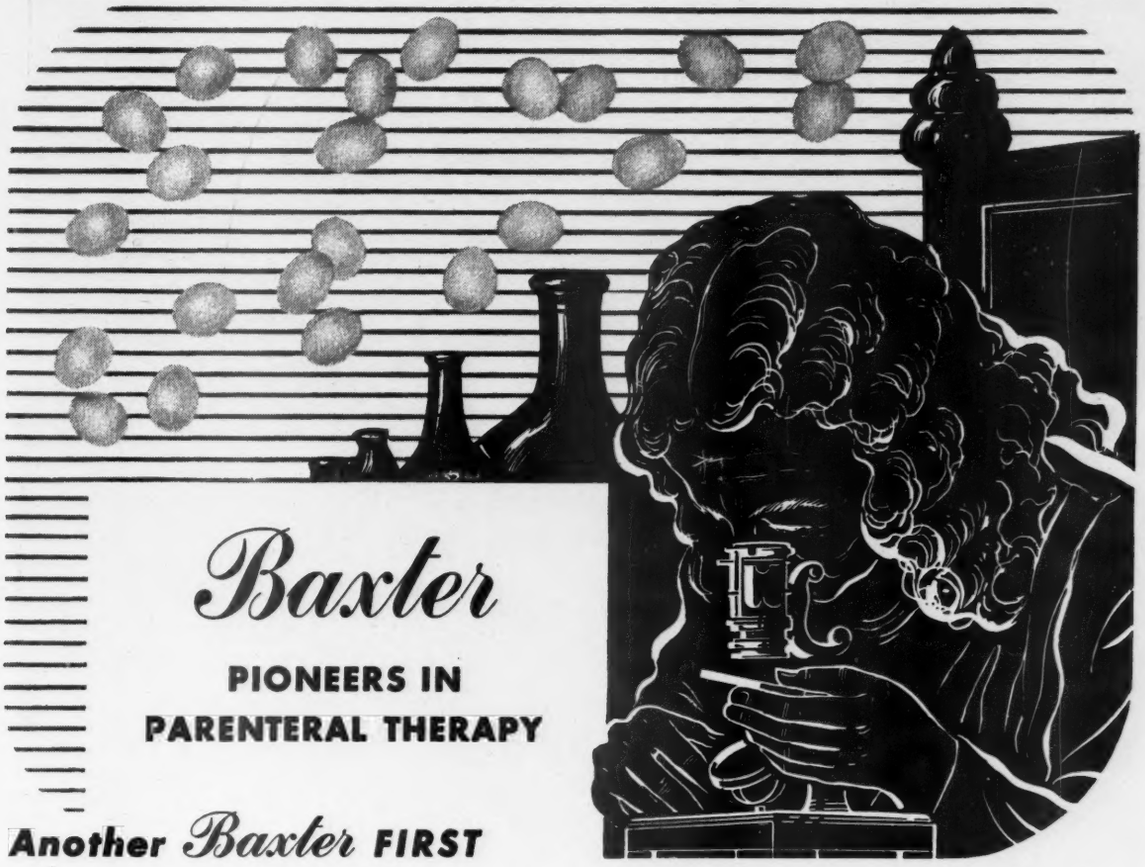

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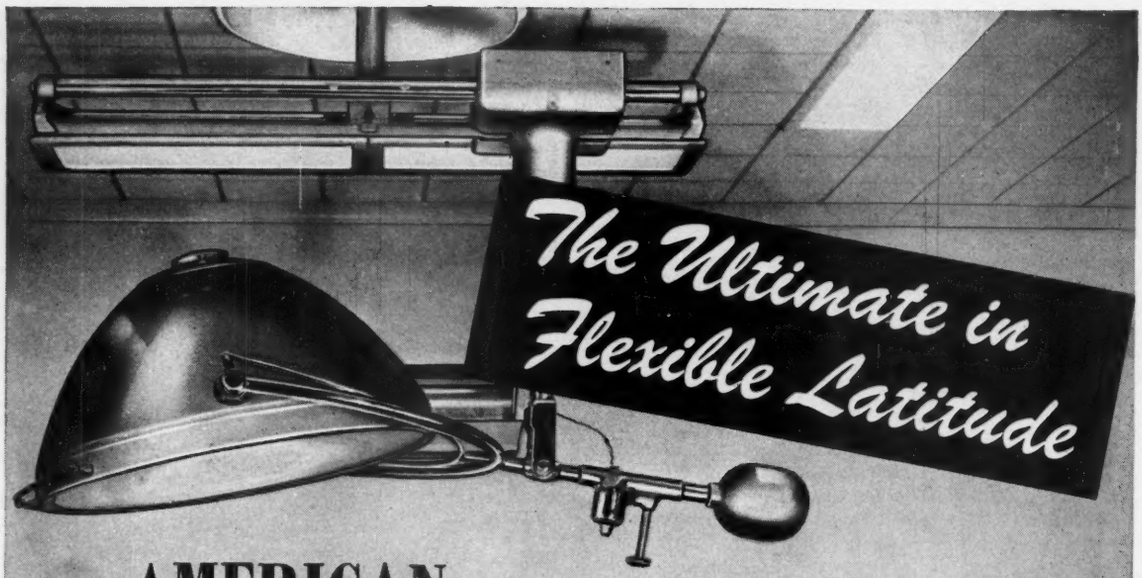

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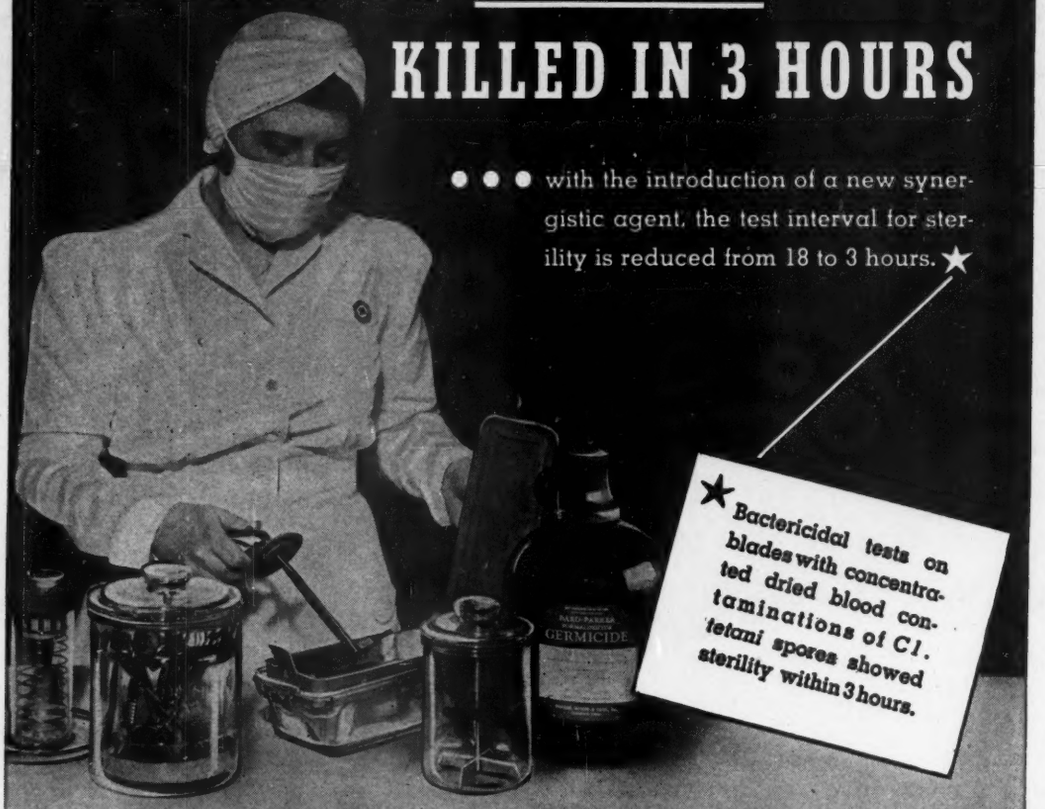

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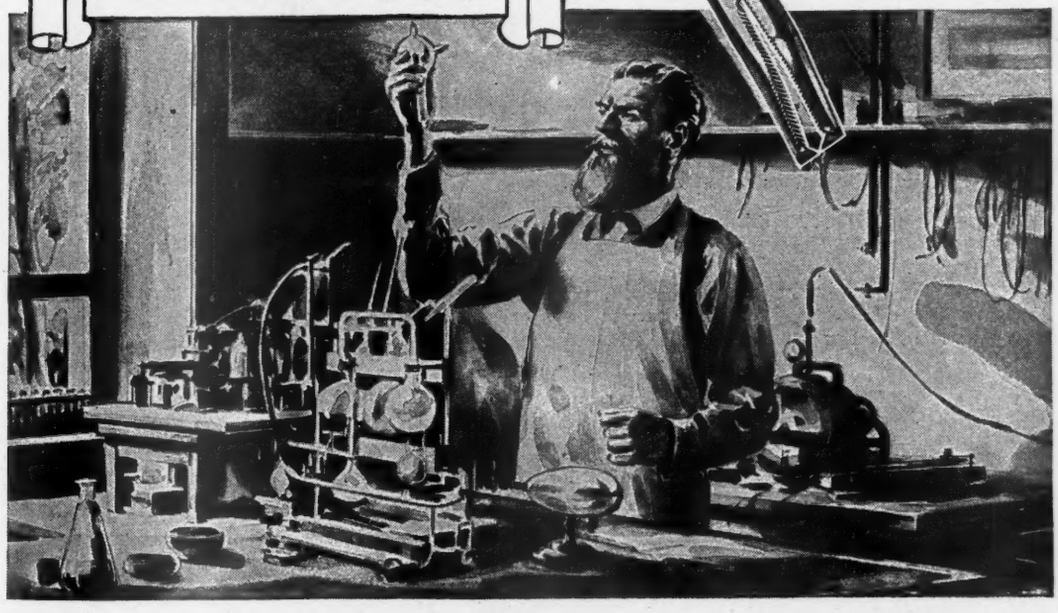

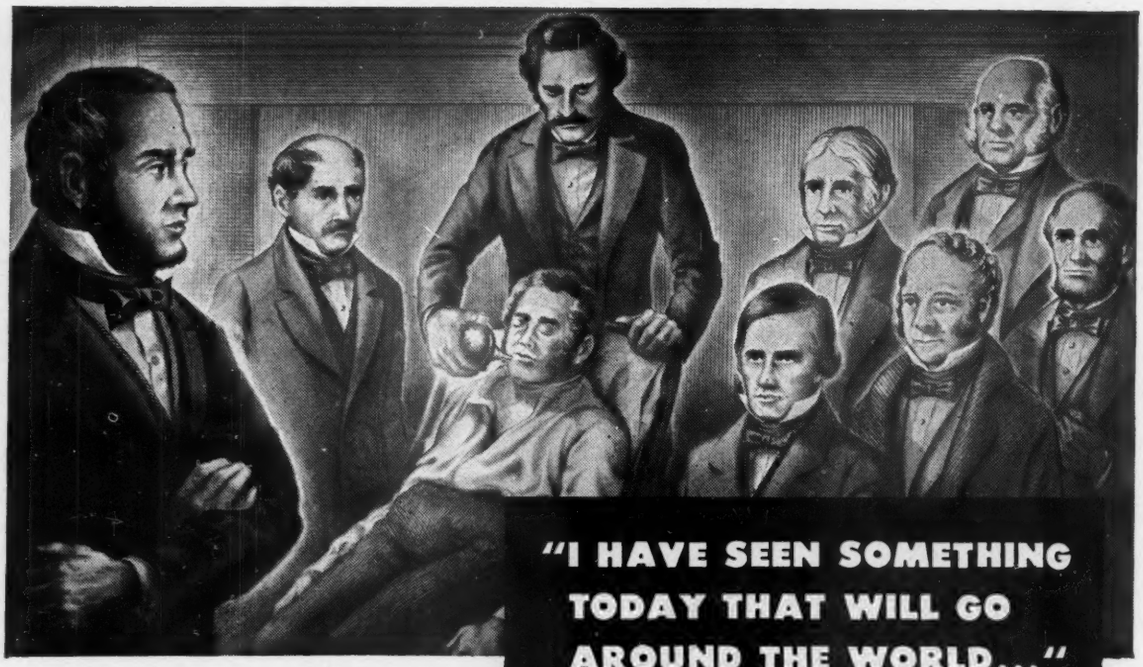

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1 Davison, F. R.: Synopsis of Materia Medica, Toxicology, and Pharmacology, 3rd ed., St. Louis, Mosby, 1944.

2 MacIntosh, R. R., and Pratt-Bannister, F. B.: Essentials of General Anaesthesia, 3rd ed., New York, Oxford University Press, 1943.

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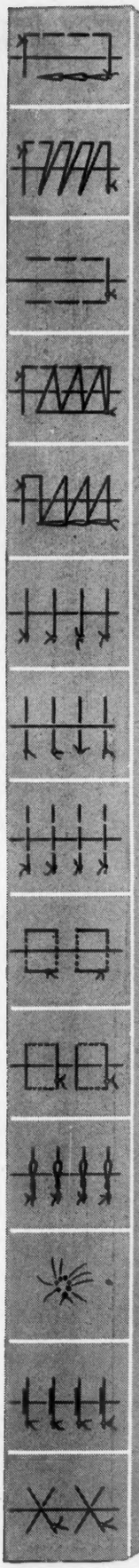

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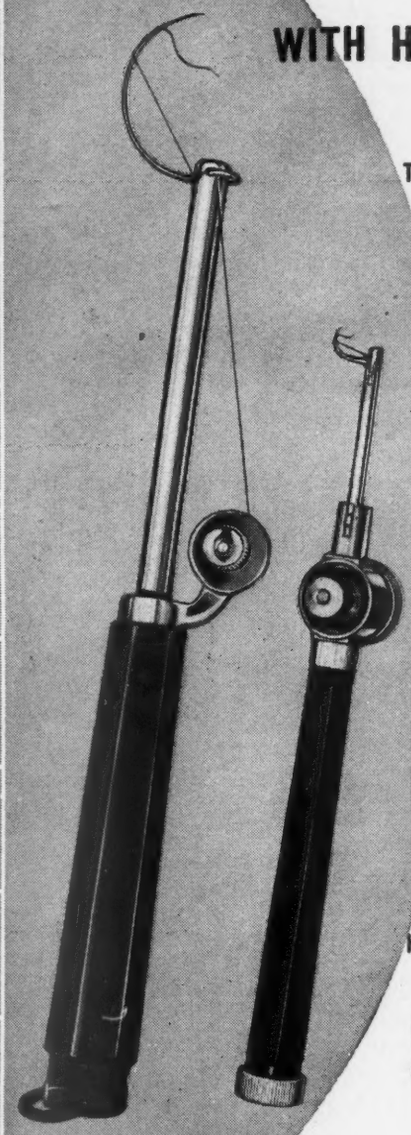

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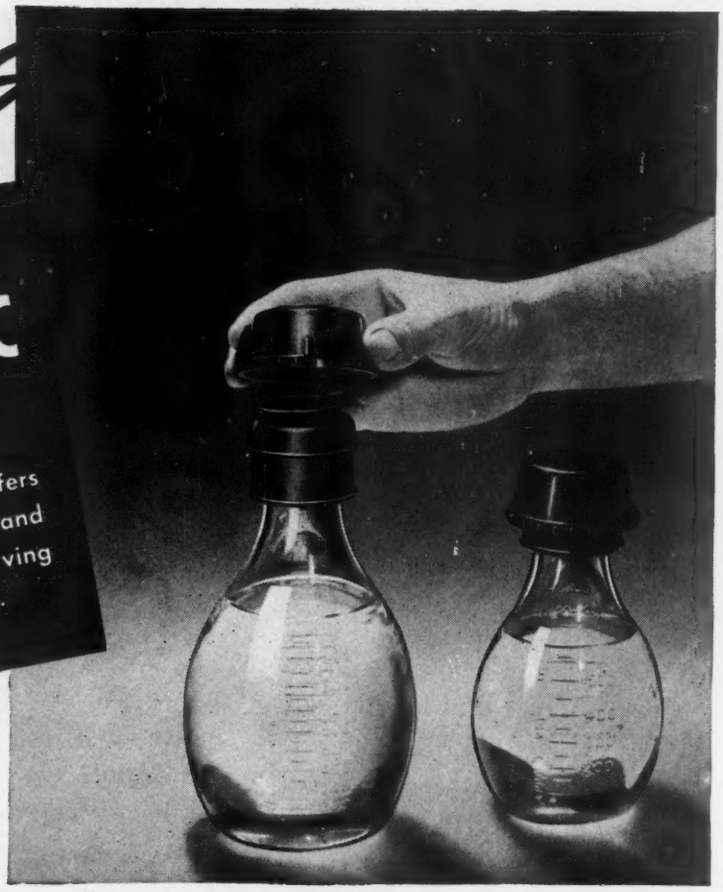

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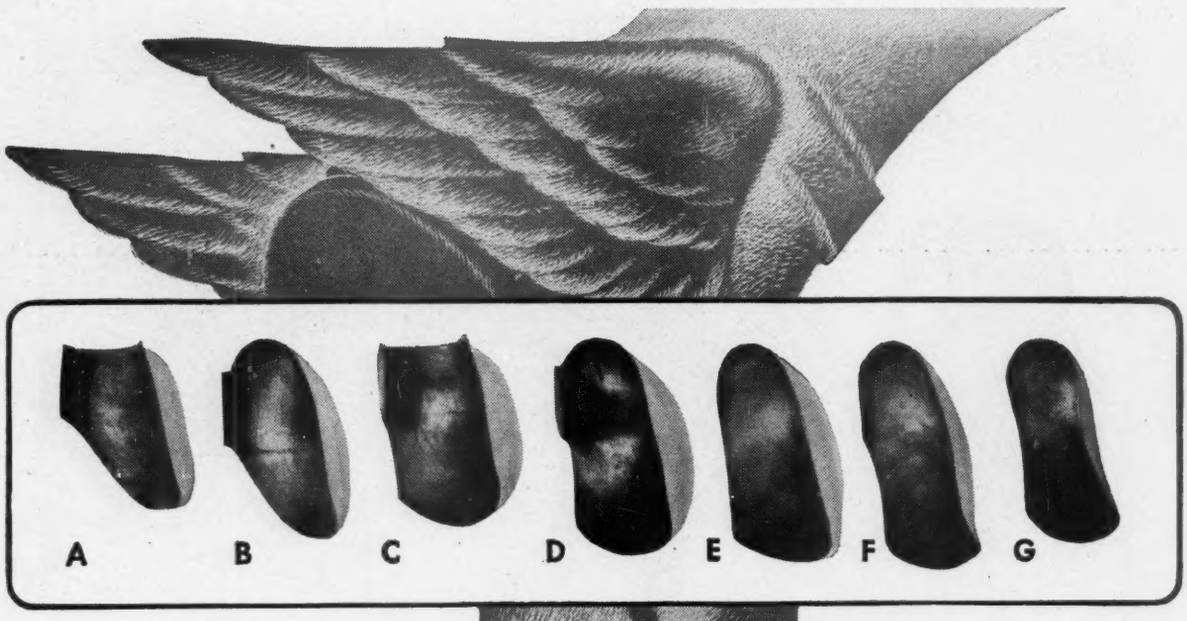

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*Reprints of the paper on this subject which appeared in The Journal of the National Association of Chiropodists, Jan. '46, will be furnished on request.

†Typical examples: A. Whitman rocker appliance; B. Modified Whitman with heel cup; C. Modified Whitman with metatarsal raise; D. Modified Whitman with heel cup and metatarsal raise; E. Simple foot plate; F. Combination metatarsal and longitudinal arch appliance; G. Metatarsal appliance.

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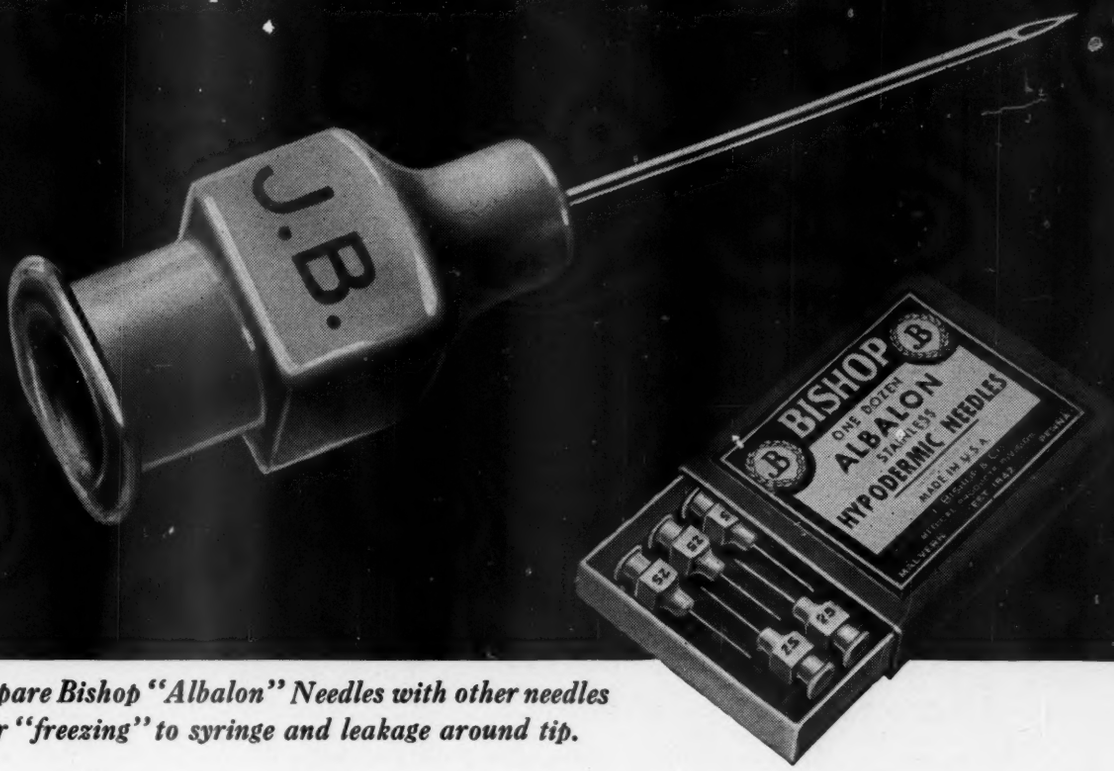

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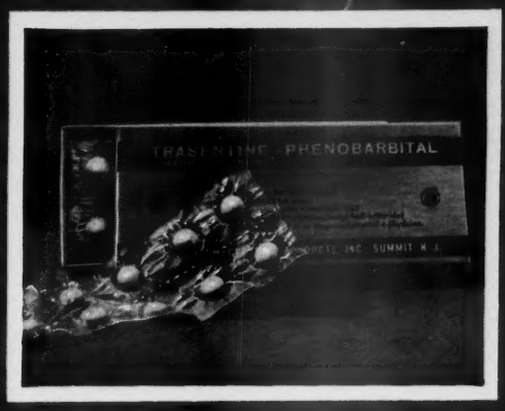

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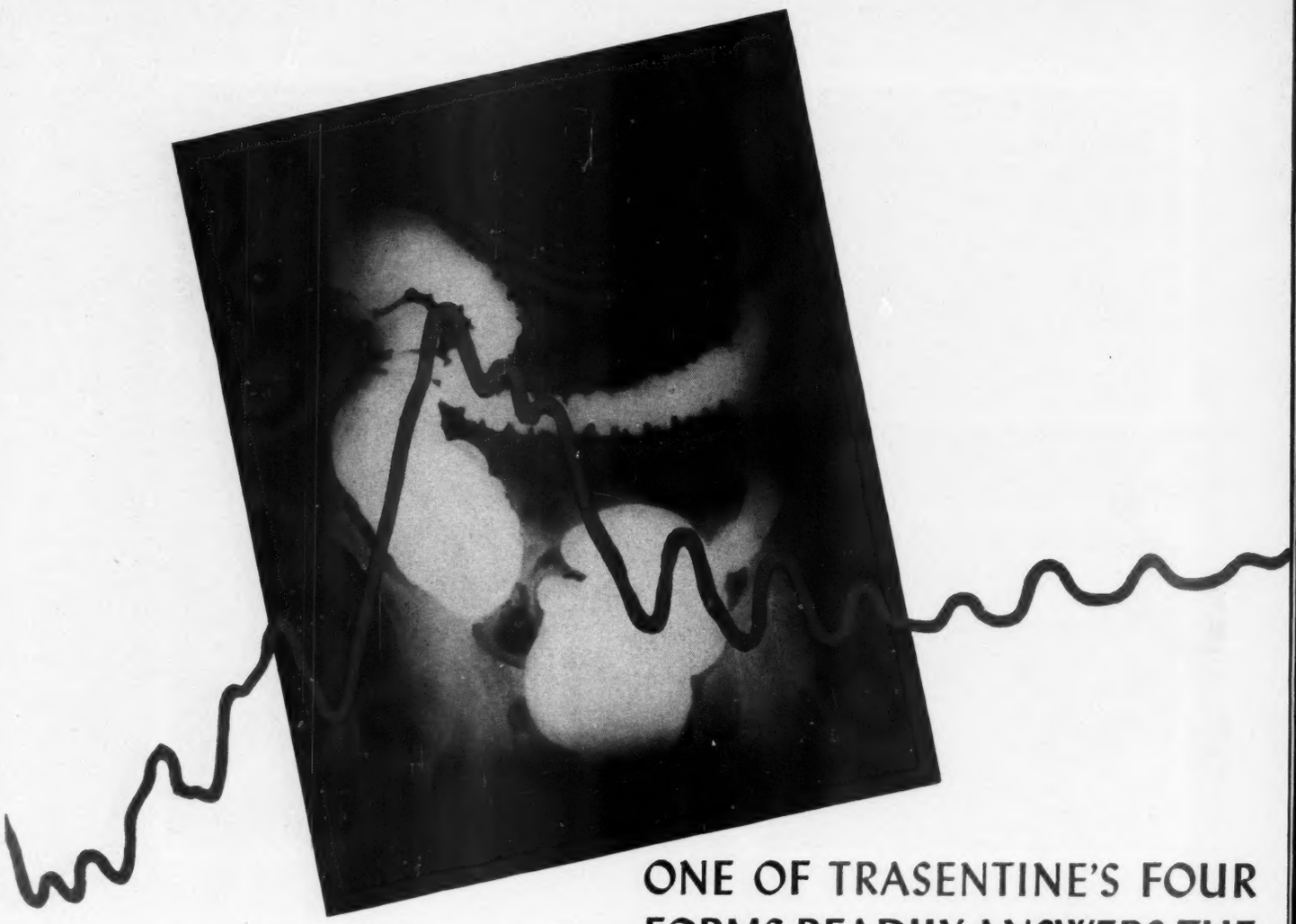

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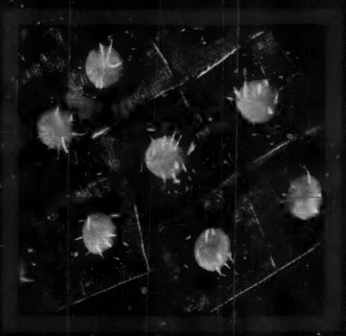

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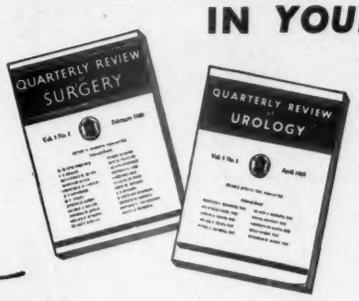

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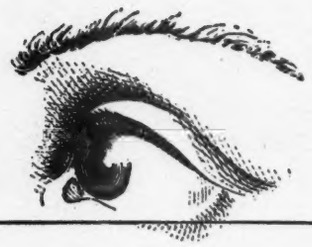

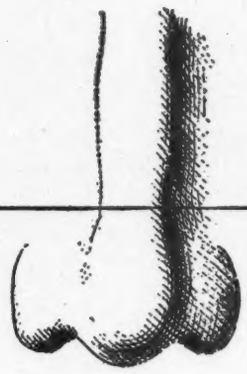

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[1] Iost, V. J., and Kochergin, J. G.: Cod-Liver-Oil Treatment of Wounds, J.A.M.A. 106:586 (Feb. 15) 1936.
[2] Hardin, P. C.: Cod-Liver-Oil Therapy of Wounds and Burns, South. Surgeon 10:301 (May) 1941.
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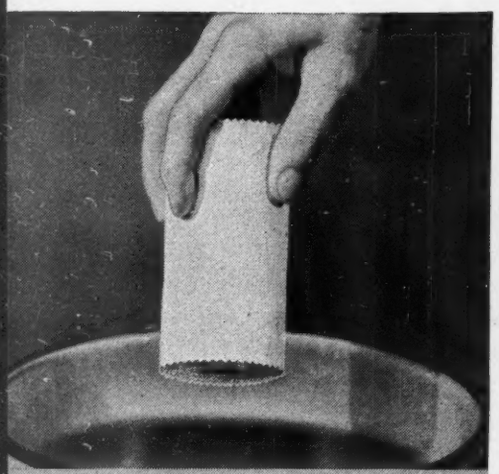

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Editorial

APPENDICITIS IN COMBAT ZONE AS SEEN IN A FIELD HOSPITAL

THE August, 1944, edition of the American Journal of Surgery contains an editorial by Captain J. E. Porter and Lieut. Commander G. H. Pratt of the United States Navy on "Operations in the Tropics." This reviews the "experiences in a United States Naval base hospital" and draws certain conclusions. One of these is that "right sided abdominal pain should be considered appendicitis until proven otherwise." The implication is that in the light of present therapy, all these patients should be operated upon.

This point was the subject of much discussion in the pre-invasion period in the United Kingdom at our staff conferences. The question was whether prophylactic appendectomy should be done at once in such cases, or whether, in the absence of definite signs of organic disorder, this could be delayed. Proponents of immediate operation believed that the trouble would recur, and that operation, even though immediately removing a man from his unit and training program, was inevitable. It was also suggested that the chances for survival would be better since the attack might occur when and where medical care was not available. Proponents of delay thought that recurrence (1) was not assured, and (2) if it happened operation added little or no risk in view of the prospective medical set up. Meanwhile, a valuable man was left in the unit and allowed to complete training toward the objective for which he had been inducted. In other words the danger to the individual was believed to be so slight as to be outweighed by the greater good of the whole army.

The question of the presence of "invasion appendicitis" occurred not infrequently in the differential diagnosis. It was noted that during the five months the same units were serviced, rehospitalization of patients not operated upon occurred within several weeks of the original admission, if at all.

It was proposed to study cases (twenty-two) in the patients operated upon in the combat zone in July and August, 1944, in the light of (1) history of previous hospitalization for the same symptoms and (2) morbidity and mortality compared to a series (forty-seven) done in the pre-invasion period (November 1943 to April 1944). The cases studied were done by the same hospitalization unit of a field hospital and the surgical team attached at the time. The entire hospital was acting as a combined station hospital and holding unit at the time. It was supplying medical and

surgical service to the surrounding service units while receiving patients for evacuation from divisional field and evacuation medical units, and also some battle casualties directly from the front lines.

Twenty-two patients diagnosed as cases of appendicitis were operated upon in the field. Twenty were found to have definite disease grossly, one was negative and one was found to be suffering from a right ureteral calculus. Due to pressure of work and also to the use of Forms MD 52c and 52d, a record of previous hospitalization for similar complaints was not noted. In fifteen of these cases seen by the writer, there was no history of previous hospitalization.

A comparison of symptomatology was interesting in that, as expected, the symptoms were more definite and the findings clearer. The only questionable cases were the two noted above. One was a combat exhaustion case with symptoms of twelve hours' duration which became worse while in the holding unit. After twelve hours' observation, he was explored and a normal appendix found. There was moderate increase in the white and differential count. At the time all patients were being evacuated to the United Kingdom and the time of evacuation was uncertain. The other patient was admitted at night from an advanced unit with the diagnosis of acute appendicitis and was operated upon at once. The symptoms and history were considered typical. Persistence of symptoms and subsequent urinalysis revealed the true diagnosis.

The remaining eighteen cases showed advanced pathological conditions as compared to those in the United Kingdom series. So-called mild cases of catarrhal appendicitis were not seen. In this series the appendix was markedly injected and swollen with free fluid in almost all patients. One case of diffuse peritonitis was encountered. This was in a service soldier who was admitted with a temperature of 105°F. and a nasopharyngitis. The abdominal symptoms were generalized with a white count of 25,000 with 91 per cent polymorphonuclears. The Ochsner treatment plus sulfadiazine and penicillin were used, and the appendix removed on the fourth day through a McBurney incision. The appendix was of the pelvic type and was walled off by the surrounding bowel. The wound was packed to the peritoneum with vaseline and left open after the method advocated by Kennedy of Philadelphia. Convalescence was uneventful, and he was evacuated on the fifth day. The wound was still open but the packing had been removed and the incision was clean. The patient was on soft diet and had had a normal bowel movement. No cultures or microscopic studies of the appendices were made due to lack of facilities.

There were no fatalities in either series. A comparison of morbidity was not possible due to the fact that the field cases were evacuated on the seventh day with the exception of the peritonitis case. This was sent out earlier due to the fact that the hospital was moved.

Complications were confined to one patient who had a series beginning with pneumonia, followed in sequence by dehiscence, intestinal obstruction of small bowel through a tear in the omentum and, finally, thrombophlebitis of the left leg. He finally cleared up and was evacuated on the fourteenth day. A right rectus incision was used. The appendix was of the suppurative type. Spinal anesthesia was used.

Postoperative pneumonia occurred in one patient in the United Kingdom series, also done under spinal anesthesia.

There were no wound infections grossly in the Normandy cases. One wound infection occurred in the United Kingdom series, following soiling in the removal of a large mucocele type of appendix. This was the size of a thumb and acutely inflamed. From the above it is evident that there were no more postoperative difficulties in the field than under garrison conditions.

Sterilization of linen supplies was done by the field type (gasoline) sterilizers in

both series. Spinal anesthesia was used in all the field cases and most of the garrison cases. Some failures were noted, contributed to, in part it was thought, by the use of other than American preparations. Ether and sodium pentothal were used for supplementary anesthesia when necessary.

In conclusion, experience in a small number of cases diagnosed acute appendicitis operated upon in combat zone, as compared to a larger number operated under garrison conditions, indicates that cases seen are farther advanced pathologically in the combat zone. The results as far as morbidity and mortality showed no demonstrable difference. No conclusions as to the necessity for prophylactic appendectomy could be drawn, aside from the negative one that the factor of safety was not decreased in the combat zone. The necessity for routine urinalysis in all abdominal cases was emphasized by the one case of ureteral calculus in which the patient was operated upon.

Major Hyman Sneierson, M.C.

Constipation is so usual in the early stages of appendicitis that when diarrhoea accompanied it the true diagnosis is liable to be overlooked. If diarrhoea is accompanied by even slight, but constant, tenderness and some rigidity in the right iliac fossa, other things being equal, the appendix should be explored.

From "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

Original Articles

A METHOD OF CONTINUOUS BRACHIAL PLEXUS BLOCK*

F. PAUL ANSBRO, M.D.

Director of Anesthesiology, Kings County Hospital; Attending Anesthesiologist, Long Island College Hospital, Brooklyn, New York

BROOKLYN, NEW YORK

THE duration and effect of anesthetic agents injected locally or regionally is, of course, limited by the inherent ability of the agents used to withstand absorption from the site of injection. Local anesthetic agents, such as, p-amino, benzoic acid esters, have a limited usefulness on account of their relatively short effect. The usual dose of the soluble type (procain) will give anesthesia for a relatively short time. The relative toxicity of long-acting agents (nupercain, pontocain) prohibit their use for brachial plexus block on account of the large quantity necessary for this procedure. Fifty cc. of 1 per cent procain will lose its anesthetic effect within forty to sixty minutes. If the operation lasts longer than the anesthetic effect of the agent, it then becomes necessary to supplement the local or regional block by a general anesthetic procedure which usually is not desired and oftentimes deliterious. This constant concern about the limitations of the anesthesia frequently causes undue haste in operative procedures. Occasionally, it is absolutely necessary to do the procedure under nerve block alone because the patient's physical economy will not withstand any other form of anesthesia. It is assumed that nerve block is the ideal procedure in the bad risk case since the least physical factors affecting the patient are brought into play. Nerve block procedures are often the method of choice over all other anesthetic procedures and are employed particularly when the stress of any procedure is considered too great for the patient's physical ability to withstand it.

Long-drawn out procedures on extremities which are done under general anesthesia frequently exact a physical price from the patient, in the way of post-anesthetic complications (atelectasis, shock, dehydration) that are all out of proportion to any possible good resulting from the operation. Thus it is evident that if a regional nerve block (brachial plexus block) could be certain to be effective and to last as long as the surgical procedure required, it would be desirous. For this reason, continuous block of the brachial plexus is employed. Heretofore, the procedure of brachial plexus block was noteworthy for its many failures. This was usually due to faulty technic in which the anesthesiologist had not properly placed his needles and the anesthetic solution had not come into contact with the nerves of the plexus. Many and various procedures were elaborated in an effort to effect a method that would be successful in all cases.

In 1911, Hirschel[1] blocked the brachial plexus through the axilla and the next year Kulenkampff[2] introduced his supraclavicular method which has been used most frequently and is safer than the infraclavicular and axillary routes. How-

* From the Department of Surgery (Anesthesiology) Long Island College of Medicine. Read before the Brooklyn Surgical Society at the Long Island College Hospital, April 4, 1946.

ever, there were frequent failures by any of these methods. Macintosh and Mushin,[3] on the basis of previous work by Patrick,[4] have proposed a method which is well adapted to prevent failures. In the writer's experience it has proved valuable and trustworthy and particularly so after a long experience with other methods in which many failures occurred. This method suggested to the writer the possibility of continuing the injections with the needle remaining *in situ* and for this purpose a suitable apparatus was devised. (Figs. 1, 2, 3 and 9.)

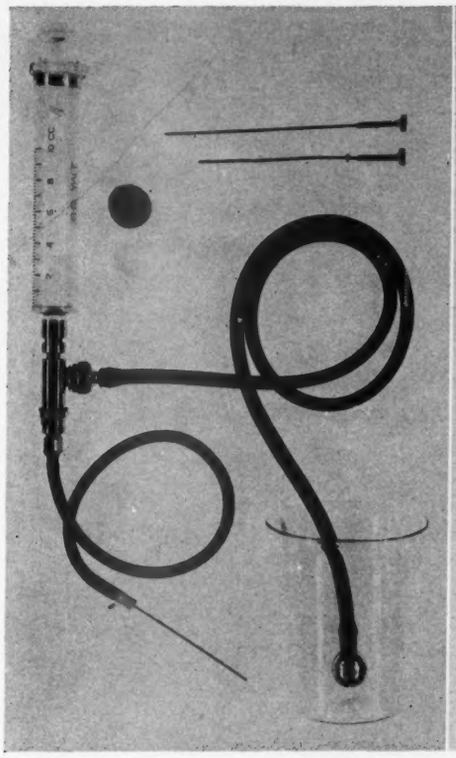


Fig. 1. Apparatus consists of a 10 cc. Luer lock syringe and the two-way valve as used in the Hingson-Edwards continuous caudal method. The tubing can be of any desired length (18 inches is sufficient). A malleable needle (Becton-Dickinson & Company) that has been filed to a blunt end to prevent perforation of blood vessels is used. A cork stopper from an ether can completes the apparatus.

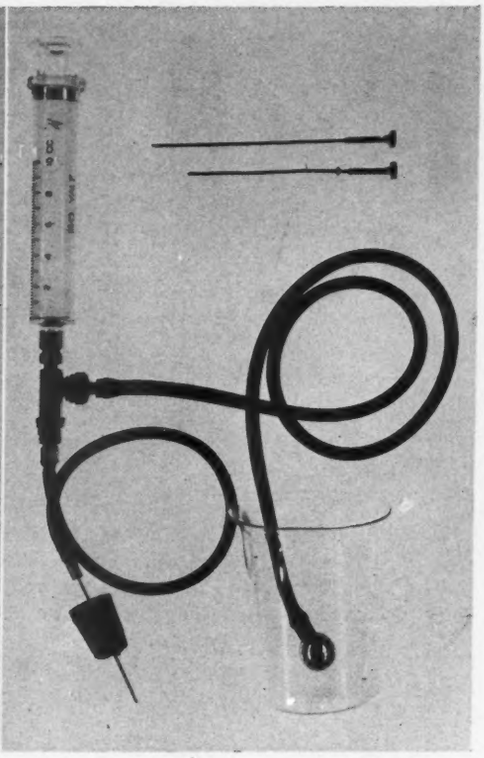


Fig. 2. Apparatus with needle through the cork, usually 4 to 6 cm.

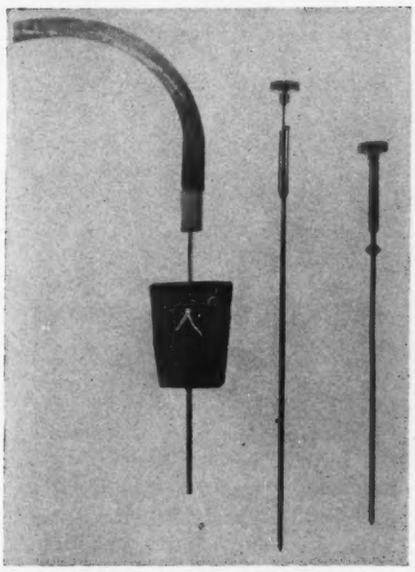


Fig. 3. Close view of blunted needle through the cork guard. The cork, when placed flush with the skin in the supraclavicular area, prevents the needle from going in deeper.

ANATOMY OF THE BRACHIAL PLEXUS

To understand and perform brachial plexus block properly, essential points in anatomy must be visualized. The brachial plexus consists of the anterior primary divisions of the last four cervical nerves (C-5, 6, 7 and 8) and the first thoracic nerve. From these five roots, three trunks

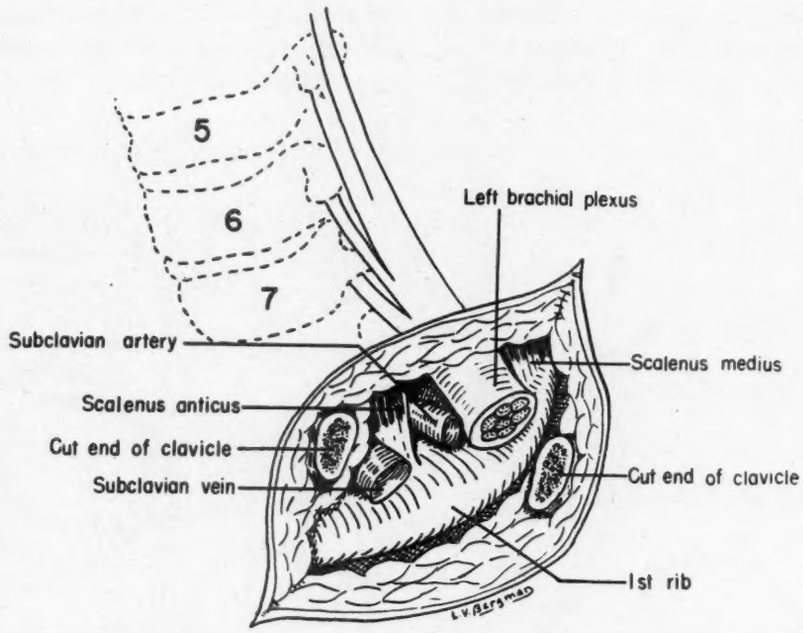
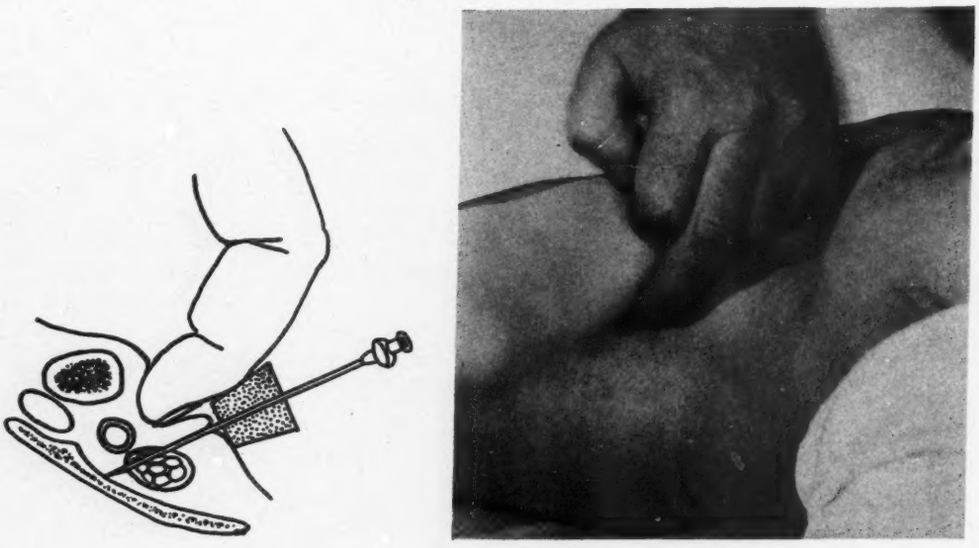


FIG. 4. Anatomical position of the brachial plexus which lies latent to the subclavian artery and between the insertions of the scalenus medius and anticus muscles. The subclavian vein is separated from the artery by the scalenus anticus muscle and lies under the surface of the clavicle and is not liable to puncture by needle.



A B

FIG. 5. A, palpating the pulsations of the subclavian artery as it crosses the first rib, the needle through the cork is guided by the palpating finger to a position lateral to the artery and in contact with it. When the needle strikes the first rib the cork is brought down flush with the skin. This maneuver holds the needle upright and prevents it from penetrating deeper. B, palpation of subclavian artery. First step in guiding needle to position lateral to it in apposition to plexus.

(upper, middle and lower) are formed which, in turn, give off six branches, an anterior and posterior branch from each trunk. All the posterior branches unite to form the lateral or outer cord from which is given off the musculocutaneous nerve and the lateral root of the median nerve. From the anterior division of the lower trunk arises the medial or inner cord which gives off the median root of the median nerve which joins with the lateral root to form the median nerve proper. The ulnar nerve is also given off from the medial cord. Thus the plexus may be said to begin with five nerves and to end with five nerves with its intermediate portions in sets of three (three trunks, three sets of anterior and posterior branches, and three cords).[5]

The nerves converge downward and outward and are closely grouped together as they cross the first rib between the fascial sheaths of the scalenus anticus muscle and scalenus medius muscle which are inserted on the first rib. (Fig. 4.) The relationship of the plexus to the subclavian artery in passing over the first rib is an important landmark in brachial plexus block. The plexus lies close, and lateral, to the artery. The subclavian vein lies under the clavicle and is not palpable. By feeling the pulsations of the subclavian artery as it crosses the first rib (Fig. 5A) and inserting a needle close by it, contacting the first rib, the plexus may be reached with certainty. In order to insure proximity to the artery, the needle should move with the pulsations of the artery. (Fig. 8.) If the point of the needle is lying on top of the first rib and is pulsating with the subclavian artery, then it, of necessity, lies in contact with the brachial plexus as it crosses the rib. By retaining the needle in its position next to the subclavian artery and holding it there by suitable means fractional injections of procain may be made.

PROCEDURE

By using a blunt needle (Fig. 3), of the malleable type, and inserting it to the lateral side of the subclavian artery in contact with the upper surface of the first rib and observing it pulsating with the artery, one may be assured that he is in the proximity of the plexus. Paraesthesias

FIG. 6. A, with finger of opposite hand above the clavicle palpating subclavian artery as it crosses the first rib, the needle through the cork is inserted through a wheal 1 cm. above the clavicle and usually at its mid-point and directed backward, inward and downward to contact the rib. The palpating finger readily guides the needle to its proper place and prevents it from perforating the artery. B, insertion of the needle downward, inward and backward. The needle has been rotated away from its correct position for the sake of clarity.

in the form of shooting pains down the arm caused by the needle contacting the plexus are helpful and give further assurance of proximity, but they are not essential to success with this technic. If procain is injected at this location in sufficient quantity, a successful infiltration of the plexus will result. The needle is blunted to prevent perforation of the artery while remaining *in situ*. By retaining the needle in this position, fractional injections of procain may be made through rubber tubing of convenient length attached to a syringe. (Figs. 1 and 2.) The needle is retained in place by the use of a cork through which the needle is inserted before passing it through the skin in the supraclavicular area. (Figs. 3 and 7.)

The cork serves the purpose of holding the needle firmly upright and in preventing its movement inward. This is accomplished by placing the cork in contact with the skin after the needle has been properly placed. (Fig. 7.) Adhesive strapping over the cork prevents outward displacement of the needle as it is held

FIG. 7.

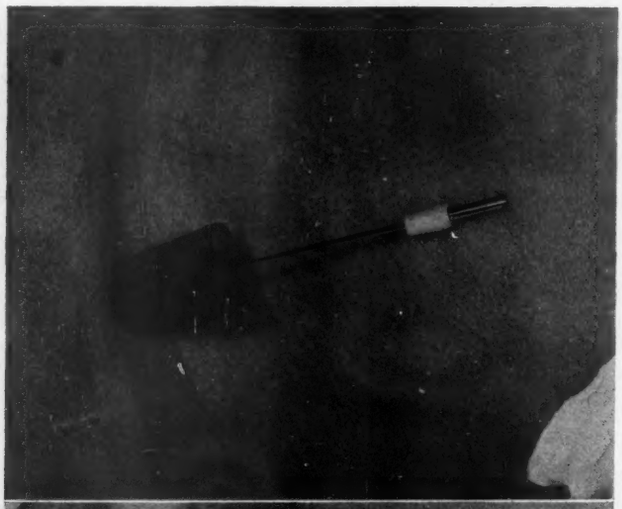


FIG. 8.

FIG. 7. Needle in place in the supraclavicular area. The cork prevents displacement inward and holds it upright.

FIG. 8. Pulsation of the needle indicating its close apposition to the subclavian artery. If the needle is placed lateral to the artery and on top of the first rib, it of necessity is in close proximity to the plexus. Injection of 30 to 40 cc. of 1 per cent procain will induce anesthesia within fifteen minutes.

securely in the cork. (Fig. 9.) One per cent procain without adrenalin is used and following careful aspiration to assure that the needle is not in a blood vessel, 40 cc. is injected as the initial dose. The onset of anesthesia may be prompt or slow depending upon the proximity of the needle to the plexus. The usual length of time is fifteen minutes following completion of the injection. It has been noted by others[3] that 1 per cent procain does not produce motor paralysis whereas 2 per cent does affect motor nerves. This finding was confirmed in this series of twenty-seven cases. The average duration of anesthesia was two hours, the longest case being four hours twenty minutes, and the shortest one and one-half hours. Good sensory anesthesia was obtained in all cases. The procedures varied from open reduction operations on bones of the forearm, arm and shoulder to repair of the median nerve and palmaris longus tendon. For shoulder operations an additional injection must be made at the fourth cervical transverse process to block C4 nerve which supplies the skin of the shoulder. In one case this single injection lasted for the entire procedure (two and one-half hours). Infiltrating the skin area above the clavicle and acromion and circularly about the axilla along its thoracic surface may also be done to block the superficial branches of the cervical plexus.[6]

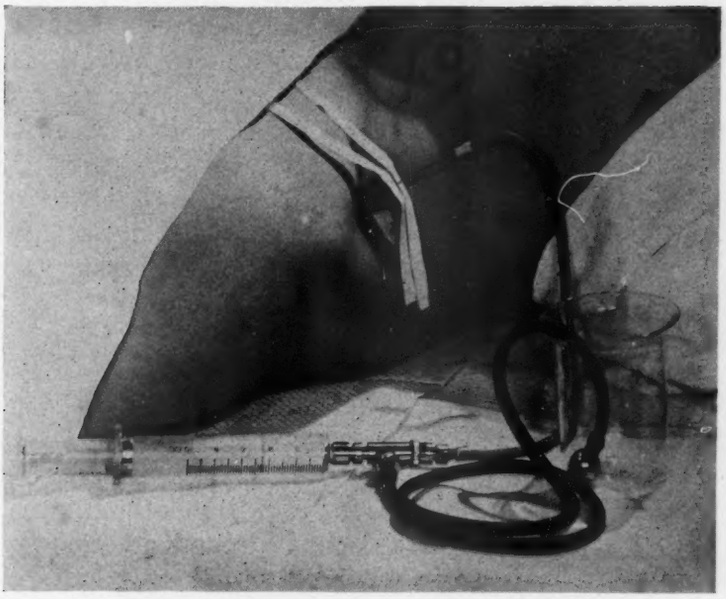


Fig. 9. Apparatus in place and ready for fractional injections. The adhesive strapping over the cork keeps the needle in place and prevents its outward displacement. The cork firmly holding the needle prevents its inward displacement.

There were slight toxic effects noted in three cases (sweating, pallor) but no change in blood pressure, pulse or respiration. The majority of the patients on returning to bed expressed a desire for food and did not require opiates for several hours after operation. Those with casts on the arm and chest were sitting up and moving about freely immediately postoperatively. The amount of solution varied from 120 cc. used in one and one-half hours to 220 cc. in four-hour cases. These dosages were within the safe range for detoxification by the body. In an early case in this series, a hematoma in the supraclavicular area developed from perforation of the artery by a sharp needle but had no ill effects. It was noted that the onset of anesthesia was greatly prolonged in this case probably due to the extravasated blood preventing procain from contacting

the plexus. Perforation of the subclavian artery is of no importance and is not likely to occur if one uses a blunt needle. A sharp needle of large gauge is used to perforate the skin and is then withdrawn. The blunt needle follows the track through the skin made by the sharp needle or the new type Hingson-Edwards needle—blunt end with sharp obturator—may be used and is more suitable. Subclavian artery perforations have been purposely done repeatedly by investigators to obtain samples of arterial blood without any harmful effects.

Horner's syndrome (ptosis, miosis and anhidrosis) was not evident in any of the patients which indicates that the solution of novacain did not extend upward through the rami communicantes to affect the stellate ganglion. However, the application of this method in peripheral vascular conditions of the upper arm is evident. This is based on the anatomy of the sympathetic components of the brachial plexus which are arranged as follows:

The anterior primary divisions of C-5 and 6 receive a gray ramus communicans from the middle cervical sympathetic ganglion. C-7 and 8 somatic nerves receive a gray ramus from the inferior cervical sympathetic ganglion. The first thoracic nerve is connected by two rami communicantes with the first thoracic sympathetic ganglion. The sympathetic fibers accompany the brachial plexus and are distributed to the blood vessels. Thus block of the brachial plexus produces both a somatic anesthesia and a sympathetic anesthesia. This blocking of the sympathetic ganglion at the brachial plexus produces a vasodilatation of the arm, hand and wrist and accompanying rise in temperature in these locations without the development of a Horner's syndrome. The latter syndrome, however, may be effected by a diffusion of the procain upward along the nerve roots to the stellate ganglion. Although this has been noted by others,[3] it did not develop in any of the cases reported here. This release of vascular tone is made evident by a rise in skin temperature of the affected extremity to the extent of 4°c.

The effective use of continuous brachial plexus block involving the sympathetic supply of the arm was evidenced by its use in brachial artery embolism of cardiac origin. In this case, a painful, swollen, cold, wet and cyanotic arm and hand was replaced by a painless, warm, dry and pink extremity within two hours after continuous block of the brachial plexus was established. Unfortunately, a pulmonary embolus wrote finis to the case within another hour. On the basis of this case the utilization of continuous brachial block in upper extremity vascular accidents as a means of inhibiting vasospasm and thus promoting collateral circulation is recommended. The relief of pain in the arm during this episode was complete and came on within fifteen minutes.

SUMMARY

Twenty-seven patients requiring operation of the shoulder, arm, wrist and hand had brachial plexus block by the continuous method. Anesthesia was successful in all cases and it was not necessary to supplement any with general anesthesia. The duration of operations extended from one and one-half hours to four hours twenty minutes. The possible utility of the method in peripheral vascular conditions of the upper extremity is suggested.

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That Mothers Might Live

By DEAN CORNWELL, N. A.

Oliver Wendell Holmes, 1809-1894, reading his celebrated essay entitled "The Contagiousness of Puerperal Fever" before the Boston Society for Medical Improvement in 1843.

OLIVER WENDELL HOLMES was a young man thirty-four years of age when he wrote this famous essay on childbed fever. He had obtained his M.D. degree at Harvard Medical School just seven years before and in the interval had been for two years professor of anatomy and physiology at Dartmouth College. How he came to write it he tells in the preface to a monograph entitled "Puerperal Fever as a Private Pestilence" and published in 1855. These are his words:

"A discussion arose in a medical society of which I was a member, involving the supposed cause of a disease, about which something was known, a good deal suspected, and not a little feared. I felt that it would be doing a good service to learn what experience had to teach in the matter."

His celebrated essay was the result of this searching inquiry. It is at once a model of cold scientific reasoning and of impassioned pleading. Even today it is impossible to find in it a statement which is false or an argument which can be refuted. We can still profit by his plea never to neglect anything, whether through ignorance or prejudice, that can make childbearing safer for women throughout the world.

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INDICATIONS AND ADVANTAGES OF COMPLETE ABDOMINAL HYSTERECTOMY VERSUS INCOMPLETE HYSTERECTOMY*

CLAUDE J. HUNT M.D.
Surgical Chief, Kansas City General Hospital
KANSAS CITY, MISSOURI

BECAUSE of distressing symptoms of leucorrhea, occasional bleeding from the cervical stump or polypoid protrusion, we became dissatisfied with the operation of subtotal hysterectomy. Being inspired by the technic and results of total hysterectomy obtained by Masson, Counsellor and Sanders, we began, five years ago, to replace the subtotal with the total procedure in most cases requiring hysterectomy.

It is not, however, our purpose to precipitate a controversy between those who favor subtotal to total hysterectomy or the incomplete removal of the uterus to the complete. It is a matter of opinion whether adequate cauterization of the cervical canal and the proper repair of lacerations is sufficient as a prophylaxis against future cervical stump cancer or the disturbing local or systemic effects of latent or recurring cervical infection. This problem must be evaluated by the operating surgeon and a decision made upon his experience and clinical observation.

It is our desire to relate our experience with total abdominal hysterectomy and to explain our preference for this procedure in the vast majority of cases.

My brother, Dr. Paul Hunt, and I have performed, since 1940, the complete removal of the uterus in 243 cases, without a mortality, without an injury to the bladder or ureters and with no added hospitalization period.

Bleeding during the operation has not been a problem. Postoperative recovery has not indicated pelvic infection. This we believe to be less in the total than in the subtotal operation. As mentioned by Masson, cutting across the cervix opens a field for infection even though the canal has been thoroughly cauterized. Cauterized tissue becomes necrotic and a fertile field for infection, which is conducive to thrombophlebitis. There was one case of postoperative thrombophlebitis in this series, which subsided by paravertebral block and dicumerol in a short period, with only slight residual leg edema.

There has been only one case that presented any postoperative bleeding and this was easily controlled. Such occurrence is negligence and due to failure to close adequately the vaginal vault—in this instance, at the side of the vaginal vault suture. At this angle vaginal mucosa may retract and not be included in the suture and subsequently bleed.

The average postoperative stay in the hospital was 14.7 days. The time of operation was not prolonged appreciably over that of subtotal hysterectomy. The average time taken for operation was less than one hour. Sixty-five per cent of the patients were operated upon under spinal anesthesia, an agent which gives excellent relaxation and permits of better exposure. The average age of the patients was forty-three years; 213 were for fibromyoma, six for fundal carcinoma, four for carcinoma of the cervix, twenty for miscellaneous pelvic disorders, ovarian cysts, tubo-ovarian disease and endometriosis.

We have not encountered any of the objections often emphasized against the

* From the Surgical Section, Research Hospital. Read at Western Surgical Association Meeting, Chicago, Illinois, November 30–31, 1945.

total removal of the uterus. The vaginal vault has been well supported in all cases and there has been no shortening of the vagina except in those cases having a congenitally short vagina and where a cancer of the cervix had been treated previous to operation by radium and *x*-ray therapy, in which instance a wide vaginal cuff was removed along with the cervix. Frequent inquiries as to marital relations following this procedure have resulted in satisfactory replies in most instances. There has been no distressing leucorrhea, no periodic bleeding and naturally no carcinoma following the procedure.

We, therefore, from this experience, believe total hysterectomy is preferable in the vast majority of cases to subtotal hysterectomy for lesions requiring the removal of the uterus. We do not by any means advocate the complete removal as a routine. Each case has to be individualized and the appropriate procedure decided upon. The age of the patient, the condition of the cervix, the anatomical obstacles at the time of exploration and, as Masson has said, to some extent the wishes of the patient are to be considered.

If the patient is fat, the pelvis deep and inaccessible, the lower uterine segment fixed by fibrosis, or endometriosis with a firmly adherent rectum and rectosigmoid, total hysterectomy is contraindicated. A normal cervix in the nullipara does not necessitate the removal of the cervix. It is likewise preferable not to do so in a young individual without cervical disease or familial cancer tendencies.

However, when the individual is in the mid-period of life, near or after the menopause, has borne children, has an infected cervix, enlarged, eroded or scarred by lacerations, with or without appreciable leucorrhea, we believe the cervix should be removed along with the fundus. The entire uterus should be removed in all cases when fundal carcinoma is known to be present or suspected and, in some instances in which cervical cancer has been controlled by radium and *x*-ray. It does not seem to be desirable to remove the uterine disorder and retain the most vulnerable portion from the standpoint of cancer or distressing sequelae.

CANCER OF THE CERVICAL STUMP

It is to be admitted that the incidence of cancer of the cervical stump is not great and may not be considered as an indication for total hysterectomy. Certainly not, if the mortality of the operation exceeds the incidence of cervical stump cancer. Gellborn and Spain stated that the danger from total hysterectomy is far less than that of cancer of the cervical stump. Sanders states that cancer of the cervical stump is sufficient in number to make total hysterectomy a definite indication. He had four cases last year. A mortality of less than 1 per cent in 1000 complete hysterectomies justifies this statement. Foss reports the incidence of cancer in the remaining cervical stump, from a review of sixteen authors, to be 2.60 per cent and the mortality of total hysterectomy as against subtotal hysterectomy as reported by twenty-two authors, to be 3.87 and 2.35 per cent, respectively. However, Masson reports an incidence of 4.4 per cent cervical stump cancer in a period from July 1, 1930, to December 31, 1938, as against a mortality rate of 1.2 per cent in total abdominal hysterectomy. Masson states by communication that they have seen over 200 cases of carcinoma of the cervical stump, some of them many years after the incomplete operation. Counsellor reports 666 total hysterectomies at the Mayo Clinic in 1944 with one death. Foss recently reported 200 consecutive total removals without a mortality.

During the first five years of the Ellis Fischel State Cancer Hospital, of Missouri, there were seen 416 cancers of the cervix, eleven of which were of the cervical stump, all developing three years or more after subtotal hysterectomy. There were twenty-two in which the lesion was seen in the first six months following subtotal

hysterectomy. Lockwood, in the last three years, has treated 100 cases of cancer of the cervix, sixteen of which were in the cervical stump. The longest postoperative period was thirty-two years, four less than one year and one less than six months. In addition, there were ten cases of cancer of the cervix diagnosed from the surgical specimen and by biopsy of the stump while the patients were convalescing in the hospital from supravaginal hysterectomy.

This indicates that many cases have an unknown incipient cancer of the cervix at the time of subtotal hysterectomy, which emphasizes the importance of careful investigation of the cervix before operation, often by biopsy or curettage. Meigs states that the problem of cancer of the cervical stump is a real one and that there is no excuse for not removing the cervix, except in bad risk patients and where anatomical difficulties exist. Von Graff condemns coning out the cervix as it leaves the squamous epithelium of the cervix.

Richardson, discussing the contributions of Telinde and Galvin, calls attention to the frequency of unsuspected carcinoma of the cervix found over a period of two years in the routine biopsy of every patient coming to the operating room and some in the out-patient department. During this period of time they found sixteen cases with early histologic changes in the epithelium characteristic of cancer, and after total hysterectomy and careful histologic study this diagnosis was confirmed in fifteen of these cases. Furthermore, in a series of 300 cases in which total hysterectomy had been performed for a benign lesion and cervical cancer was not suspected, it was found in four cases. Novak states that many of the earliest cancers have been in cervices which showed little or no gross clinical change.

It must be remembered that cervical cauterization protects only against adenocarcinoma of the cervix and not against the squamous cell carcinoma, which is by far the most frequent. An analysis by Allebach of the cervical cancers at the Research Hospital for a twenty-one-year period shows twenty-seven, or 10.1 per cent adenocarcinoma; and 240, or 89.9 per cent, squamous cell carcinoma, in a total of 267 cases. Also, cancer of the cervix is more lethal than cancer of the fundus. They are usually Grade III or IV, while the fundal carcinomas are Grade I and II.

BENIGN LESIONS OF THE CERVICAL STUMP

There are other reasons, however, more rational for the removal of the cervix along with the uterus than cancer. Novak says the cervix serves no function after removal of the uterus and just as good a pelvic floor can be made if it is removed. Its retention results often in troublesome leukorrhea, even if cervical cauterization or conization are done. Frequently the cervical stump has to be amputated because of this distressing condition and often periodic bleeding is so persistent that radium or amputation must be employed. We often have had this experience. Variable degrees of leucorrhea are common, after subtotal hysterectomy, but is never present after total removal. We have found an infected cervical stump and annoying leucorrhea in thirty-five of sixty patients upon whom we had performed cervical cauterization and subtotal hysterectomy. Many never had it before. Cauterization may be conducive to infection. Masson states that in more than 500 instances treatment was necessary because of cervicitis with leukorrhea. In many of these cases there was no history of this condition before the body of the uterus was removed. He believes this is due to interference with the blood supply of the cervical stump with infection in the cervical glands. Because of these reasons, in the last 2,000 hysterectomies he thinks he has not done more than fifty subtotal operations. Also, cervicitis may act as a focus of systemic infection or may be the seat of a polyp or even fibroid tumor.

ESSENTIALS OF OPERATIVE TECHNIC

The operation of total abdominal hysterectomy should never be attempted except by one familiar with the technic. It is not an operation for the occasional operator or for one not thoroughly familiar with the essentials of the procedure. It is our policy in all cases in which there is no ovarian disorder to conserve the ovaries when possible. Large lesions may so approximate the ovaries that adequate blood supply cannot be maintained. Usually one ovary can be conserved. The tubes, as emphasized by Masson, have no further purpose and may necessitate later surgery. We, therefore, usually remove the tubes. If left, their blood supply may be impaired as they must depend upon collateral circulation from the ovarian arteries, the principal supply having been abolished when the uterine arteries were ligated. Masson wisely emphasizes that the possibility of thrombophlebitis is less likely when the tubes are removed, as it eliminates slowed or stagnant circulation in the mesosalpinx.

The bladder is protected from injury by carefully stripping it down under direct vision, either by gauze dissection when not adherent or by sharp dissection. After ligation of the round ligament and division and ligation of the tubal pedicle, the ureters can be palpatated by passing the hand behind the broad ligament and the thumb in front. The ureter can be felt to roll between the thumb and index finger. Its location can be determined. The ureters are protected by placing clamps on the uterine arteries high, as stated by Masson, at the internal os, both for total and subtotal hysterectomy alike. Keep close to the uterus, do not clamp below the internal os and the ureters will be safe. If the tumor is large and access is not possible, it can be removed in piecemeal and the ureters located and the bladder protected. If bleeding in the broad ligament occurs, the ureters should be isolated.

With the bladder well dissected down below the cervix, with the uterine arteries clamped at about right angles to the internal os, divided and securely ligated by fixation suture ligature, the cardinal ligaments can be freely divided and by traction upon the uterus the cervix can be pulled up and actually enucleated from the vaginal vault, stretching to its maximum the vaginal mucosa around the cervix. The uterosacral ligaments and posterior peritoneum having been previously divided, the vaginal vault is opened with safety from behind and the cervix is removed by curved scissors at its attachment to the vaginal mucosa, conserving the entire length of the vagina. Right angle clamps placed below the cervix necessitate broad ligament dissection well below the distal end of the cervix at the side of the vault of the vagina. This is far below the point of safety of the internal os and greatly increases the danger of ureteral or bladder injury and materially shortens the vaginal vault. It is far better to open the vagina, conserve its entire length, pass through into the vagina a gauze tape saturated with tincture merthiolate and close the mucosa by an inverted suture under direct vision. No added danger of infection will result from this procedure and the advantages are evident. There would be less objection to total hysterectomy from the standpoint of safety of the procedure, ease of accomplishment and adequate vaginal depth if this method were employed.

With closure of the mucosa of the vaginal vault, support is attained by suture of the uterosacral ligaments to the anterior vaginal wall fascia or the vesical fascia, re-enforced by overlapping of the round ligaments across the closed vaginal vault. With these supporting fascial and ligamentous structures properly applied, prolapse will not occur. The vault can be and is as well or better maintained than in subtotal hysterectomy. The entire field is covered by the vesico-uterine fold of the peritoneum, leaving a perfectly peritonealized pelvic floor. Sutures should only be placed where it is definitely seen

through what structures they pass. An improperly placed suture is the most common cause of bladder injury. It is our practice to sprinkle the field lightly with crystals of one of the sulfa drugs. The abdomen is closed without drainage. The vaginal tape of tincture merthiolate is removed immediately after the abdominal closure. An adequate restoration of the perineal floor should be done, if necessary.

SUMMARY

The indications for total hysterectomy are definite and have been emphasized. Cautery of the cervix and repair of cervical lacerations are not considered desirable if total hysterectomy can be safely performed.

The mortality of total hysterectomy is less than the incident of cervical stump cancer in properly selected cases under competent hands.

None of the serious objections often mentioned are encountered when the vaginal vault is well supported and length maintained. The right angle clamp below the cervix, across the vagina as an aseptic precaution seems inadvisable. It shortens the vagina. It is better to open the vagina and reconstruct the vault under direct vision, building up a firm support by the uterosacral ligaments, vaginal fascia and round ligaments.

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ABDOMINOPERINEAL PROCTOSIGMOIDECTOMY FOR CANCER OF RECTUM*

CONCLUSIONS BASED ON FIVE YEARS' EXPERIENCE

HARRY E. BACON, M.D.

Professor and Head of Department of Proctology, Temple University Medical School and Hospital

PHILADELPHIA, PENNSYLVANIA

RESTORATION of bowel continuity following resection has attracted the attention of surgeons here and

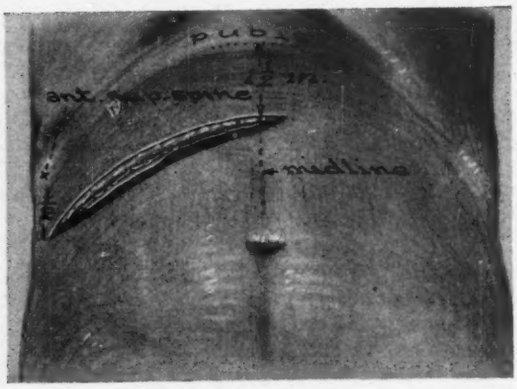

FIG. 1. Schematic drawing of incision with landmarks.

abroad ever since Reybard[1] more than a century ago successfully removed a sigmoidal cancer and immediately anastomosed the segments. Either by preservation of the sphincter musculature or by reestablishment of continuity, much progress has been made toward elimination of a colostomy for lesions of the rectum and pelvic colon.

The purpose of this discussion is to review an experience of over five years in a series of 461 cases of cancer involving the anus, rectum and pelvic colon and to appraise particularly the results obtained with the technic of "proctosigmoidectomy" as designed by Babcock in 1932.[2] In this group there were 265 males and 196 females, the extremes 17 and 85. The distribution was noted as shown in Table I. Ninety-four and four-tenths per cent were reported as adenocarcinoma and 57.9 per cent were grade II. Four hundred and twenty-four patients were operated upon, an "operability rate" of 91.9 per cent. Radical extirpation was performed in 371 patients representing a "resectability rate" of 80.4 per cent.

TABLE I

Sigmoid	58
Rectosigmoid	158
Rectum	231
Anus	14
Total	461

It will be noted that the rates of operability and resectability are based not on the number coming to operation but rather on the number of cases examined. If one were to exclude those who had been operated upon elsewhere but sought an opinion, inoperable patients who were referred to a roentgenologist for therapy or those who refused operation, it is obvious that the rates of both would be higher than is evident in Table II. There were twenty-five deaths in 424 operations—operative mortality 5.8 per cent or twenty-three deaths in 371 resections—mortality from resection 6.1 per cent. If the various stages of multiple procedures are included, as well as preliminary enterostomies and closures, sphincteroplasties, removal of redundant bowel and the like, the 424 patients underwent eighty-two additional procedures or 506. On this basis the operative mortality is 4.9 per cent.

The disposition of the 461 patients is shown in Table II.

Radical extirpation was performed in 371 of the 461 cases—a resectability rate of 80.4 per cent. The technic employed is shown in Table III.

More and more has it been realized in our department that sigmoidal cancers, espe-

* Read before the Detroit Academy of Surgery, October 11, 1945.

cially those low in the pelvic colon, can be widely resected with immediate end-to-end anastomosis, and similar lesions in the rectum can be removed without the establishment of an abdominal colostomy and with preservation of the sphincter musculature. It will be observed that of the 371 resections, 262 or 70.6 per cent were performed without an abdominal colostomy and of this number, 236 or 63 per cent were operated upon by the technic of "proctosigmoidectomy."

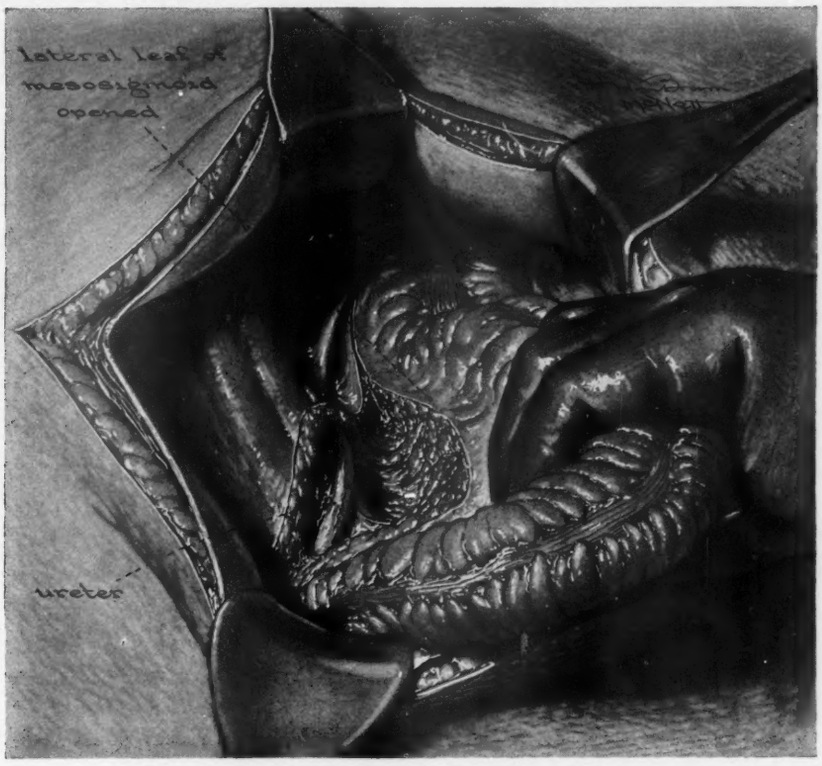

Fig. 2. Mobilization of sigmoid begun by incision of lateral leaf. Ureter is identified and retracted.

Table II

	No. Patients	No. Patients Operated upon	Operability Rate	No. Deaths from Operations	Mortality Rate from Operations	No. Patients Resected	Resectability Rate	No. Deaths from Resection	Mortality Rate from Resection
No procedure recommended	5								
Palliative colostomy	31	31		2	6.4				
Local excision (Bevan) alone or with radium implantation	14	14	.....	..	0				
Exploration only	8	8	.....	..	0				
Fulguration	21								
Refused operation or sought counsel elsewhere	11								
Resection	371	371	.....	23	6.1	371	.....	23	6.1
Totals	461	424	91.9%	25	5.8	371	80.4%	23	6.1

It has become apparent that the views held by Miles[3] as to the lateral and espe-

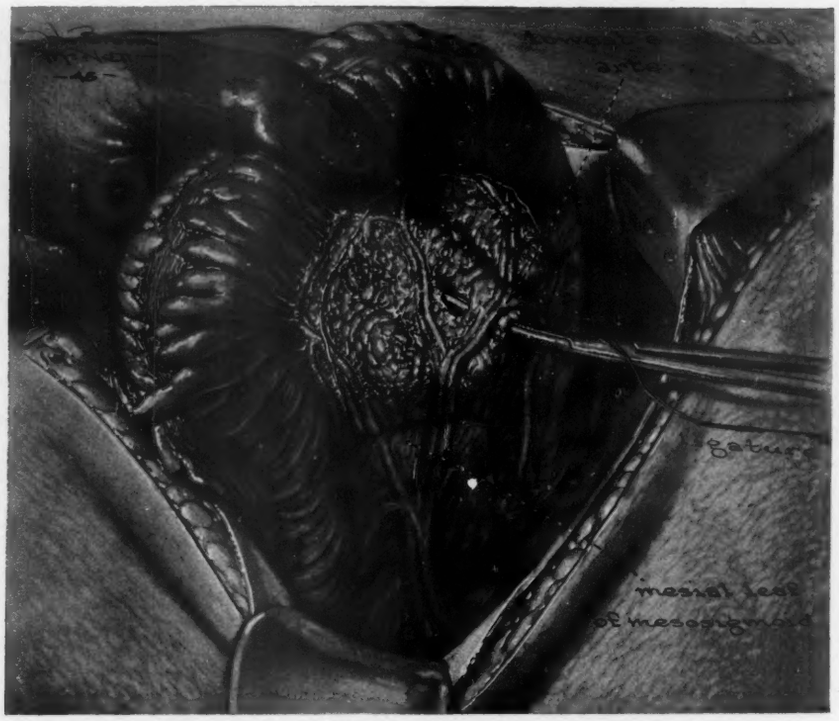

FIG. 3. Incision of medial leaf. Inferior mesenteric, left colic and sigmoidal vessels are shown and point of division.

FIG. 4. Mobilization from abdominal phase is now complete. Hand is introduced into presacral space as far as sacrococcygeal articulation.

cially the inferior zones of spread necessitate some modification inasmuch as Westhues[4] has given striking evidence that cancerous connective tissue and lymph node metastases are located at the level of the carcinoma or above it. Dukes and Bussey[5] have confirmed these findings. Coller,[6,7] in his investigations found no evidence of retrograde metastasis to nodes situated 5 cm. below the primary site, and no metastasis along the lateral zone of spread where the inferior border of the lesion was 3 cm. or more above the mucocutaneous junction (anorectal line). It may be deduced, therefrom, that the inferior zone of spread is relatively unimportant.

Table III

	No. Cases	Deaths	Percentage
Abdominoperineal proctosigmoidectomy—Babcock	236	15	6.3
Abdominoperineal excision—1 stage—Miles	51	2	3.9
Abdominoperineal excision—2 stage—Lahey	6	1	16.6
Sigmoidectomy—multiple stage—Mikulicz	27	2	7.4
Sigmoidectomy—primary anastomosis—Babcock or Furniss	24	2	8.3
Perineal excision with colostomy—Lockhart-Mummery	14	1	7.1
Anterior resection—Hartmann	9	0	0
Perineo-abdominal excision—Turner	2	0	0
Perineal excision—Cuneo-Seneque	2	0	0
Totals	371	23	6.1

The accompanying chart shows a group of forty-nine of seventy consecutive cases in which an abdominoperineal proctosigmoidectomy was performed. Dr. Ernest E. Aegerter, Professor of Pathology, personally supervised the serial sectioning of the postoperative bowel specimens at 2, 4 and 6 cm. below the growth. It will be observed that only in Case 3 was evidence of malignancy disclosed in each section; Case 20 showed malignancy at 2 cm. below the growth but not at other distance. In other words, one of the forty-nine cases disclosed cancer at a distance of 6 cm. (2.0 per cent). It is our opinion that the

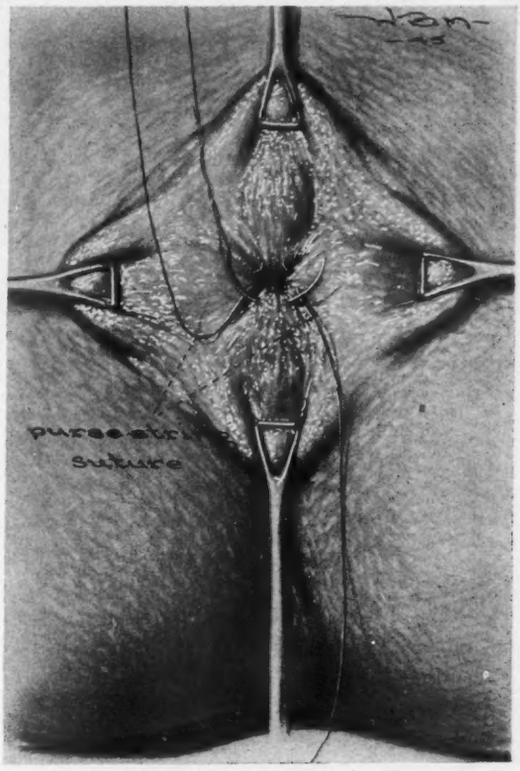

Fig. 5. Purse-string of stout silk introduced through the tough squamous epithelium of the anal wall immediately below anorectal line. Ends are left long for traction.

sphincter musculature may be preserved provided the lower border of the growth is 6-cm. or more above the anal margin.

Based on a series of 1,995 cases of malignancy of the anus, rectum and sigmoid colon, in which the precise location of the tumor was noted in 1,401 instances, the writer[8,9,13] found that only 10.2 per cent of lesions occurred within the distal 5.5 cm. of the bowel and 19.1 per cent were within the distal 8 cm. (above the anal margin). If all growths located in the distal 8 cm. area are excluded, 80.9 per cent occur in the situation above. In brief, 80 per cent of the cancers involving the distal loop do not necessitate sacrifice of the sphincter musculature.

It is obvious that preservation of the sphincter musculature does not jeopardize the radicability of the operation, for

TABLE IV

No.	Initials	Age	Sex	Type	Grade	Type of Resection	Cm. Bowel Removed	Circumference of Lesion	Section below Growth		
									2 Cm.	4 Cm.	6 Cm.
1	E. McR.	63	M	Adenoca.	II	AP.P.*	27	Entire	0	0	0
2	F. W.	62	F	Adenoca.	II	AP.P.*	25	¼	0	0	0
3	W. O.	52	M	Adenoca.	II	AP.P.*	31	Entire	+	+	+
4	G. S.	55	M	Adenoca.	III	AP.P.*	26	Entire	0	0	0
5	T. D.	55	M	Adenoca.	III	AP.P.*	25	Entire	0	0	0
6	P. C.	39	M	Adenoca.	II	AP.P.*	43	½	0	0	0
7	E. R.	42	F	Adenoca.	II	AP.P.*	19	¾	0	0	0
8	M. B.	66	M	Adenoca.	II	AP.P.*	22	Entire	0	0	0
9	S. L.	65	F	Adenoca.	II	AP.P.*	13	Entire	0	0	0
10	D. C.	36	F	Adenoca.	II	AP.P.*	21	Entire	0	0	0
11	P. G.	57	M	Adenoca.	II	AP.P.*	19	Entire	0	0	0
12	J. K.	58	M	Adenoca.	III	AP.P.*	30	Entire	0	0	0
13	S. A.	42	F	Adenoca.	II	AP.P.*	24	¼	0	0	0
14	J. P.	52	F	Adenoca.	II	AP.P.*	10	⅛	0	0	0
15	J. R.	60	F	Adenoca.	II	AP.P.*	39	Entire	0	0	0
16	F. A.	58	M	Adenoca.	II	AP.P.*	19	Entire	0	0	0
17	M. D.	49	M	Adenoca.	II	AP.P.*	20	⅛	0	0	0
18	E. H.	74	F	Adenoca.	II	AP.P.*	30	Entire	0	0	0
19	E. S.	64	M	Adenoca.	IV	AP.P.*	30	¾	0	0	0
20	E. V.	58	F	Adenoca.	III	AP.P.*	19	Entire	+	0	0
21	A. R.	72	F	Adenoca.	II	AP.P.*	28	¾	0	0	0
22	E. H.	57	M	Adenoca.	II	AP.P.*	22	¾	0	0	0
23	B. W.	38	M	Adenoca.	III	AP.P.*	16	¾	0	0	0
24	L. W.	39	F	Adenoca.	II	AP.P.*	26	¼	0	0	0
25	H. K.	62	F	Adenoca.	II	AP.P.*	29	Entire	0	0	0
26	B. O.	40	F	Adenoca.	II	AP.P.*	24	Entire	0	0	0
27	C. T.	58	M	Adenoca.	I	AP.P.*	25	½	0	0	0
28	J. B.	44	M	Adenoca.	II	AP.P.*	19	Entire	0	0	0
29	E. S.	72	M	Adenoca.	II	AP.P.*	21	Entire	0	0	0
30	R. B.	58	M	Adenoca.	II	AP.P.*	20	Entire	0	0	0
31	M. P.	65	F	Adenoca.	II	AP.P.*	26	Entire	0	0	0
32	A. K.	53	F	Adenoca.	II	AP.P.*	17.5	¾	0	0	0
33	V. C.	60	M	Adenoca.	II	AP.P.*	19	¾	0	0	0
34	C. B.	68	M	Adenoca.	II	AP.P.*	21	Entire	0	0	0
35	S. B.	56	M	Adenoca.	II	AP.P.*	24	Entire	0	0	0
36	V. L.	56	M	Adenoca.	II	AP.P.*	16	Entire	0	0	0
37	G. G.	61	M	Adenoca.	III	AP.P.*	30	Entire	0	0	0
38	J. F.	45	F	Adenoca.	II	AP.P.*	33	Entire	0	0	0
39	M. R.	59	F	Adenoca.	II	AP.P.*	20	½	0	0	0
40	A. V.	64	F	Adenoca.	II	AP.P.*	22	¾	0	0	0
41	P. G.	41	F	Adenoca.	III	AP.P.*	14	Entire	0	0	0
42	G. McF.	73	M	Adenoca.	II	AP.P.*	20	¾	0	0	0
43	L. K.	35	F	Adenoca.	II	AP.P.*	29	¾	0	0	0
44	W. G.	66	M	Adenoca.	II	AP.P.*	24	¾	0	0	0
45	J. C.	55	M	Adenoca.	I	AP.P.*	21	Entire	0	0	0
46	W. H.	41	M	Adenoca.	II	AP.P.*	17	¾	0	0	0
47	A. DeG.	68	M	Adenoca.	II	AP.P.*	33	Entire	0	0	0
48	A. K.	55	M	Adenoca.	III	AP.P.*	22	¾	0	0	0
49	H. T.	32	F	Adenoca.	II	AP.P.*	20	Entire	0	0	0

* Abdominoperineal proctosigmoidectomy.

Mandl[10,11] in a series of over 1,000 operations found the percentage of three-year cures higher when the sphincter apparatus was preserved than when sacrificed. He maintains that similar results were obtained by Eichhoff (Kuttner Clinic) and by Pribam (Payr Clinic). The survival rate of our cases following "prostosigmoidectomy" slightly better than parallels the results obtained by the usual type of abdominoperineal extirpation.

Survival	
Three years or more	58.6%
Five years	50. %
(based on 81 cases)	

After the method of David and Gilchrist,[14] we have analyzed 185 of our 236 patients on whom the writer performed an abdominoperineal proctosigmoidectomy, whereby, ninety may be classified as "favorable" with no question as to resectability, and ninety-five cases in which one or more factors clouded resectability.

Fig. 6. Sagittal section through pelvis showing relationship of structures and the extent of inferior mobilization by arrows from the abdominal phase A anteriorly, and B posteriorly. Note position of sphincters: I. S.—internal sphincter; E. S.—external sphincter and longitudinal muscle fibers.

Fig. 7. Sagittal section showing the position and relationship of musculature by traction on purse-string suture.

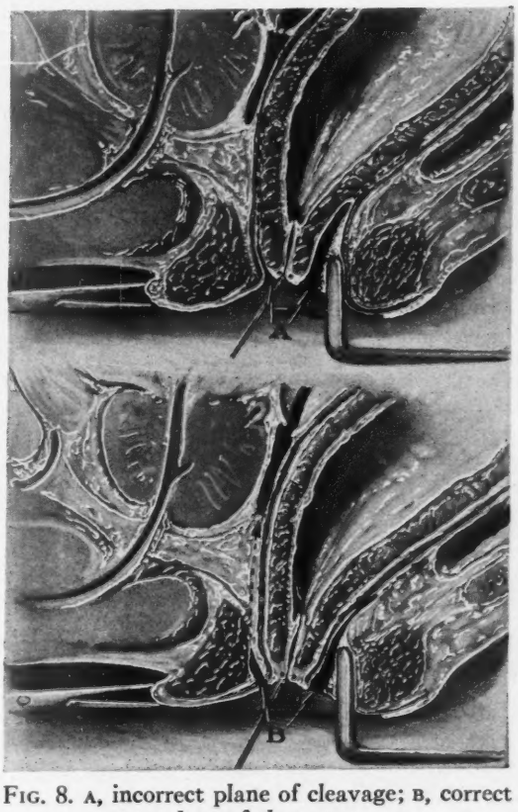

Fig. 8. A, incorrect plane of cleavage; B, correct plane of cleavage.

TABLE V

	No. Cases	Deaths	Mortality Per Cent
Abdominoperineal proctosigmoidectomy—no colostomy—sphincter muscles preserved	185	11	5.9
A. Favorable cases for resection	90	3	3.3
B. Doubtful cases for resection	95	8	8.4

The factors for which resectability was considered doubtful are appended in Table VI:

TABLE VI

Involvement of—small intestine (resection in all)	6	
Bladder (partial resection)	6	
Uterus and adnexa (resection in all)	4	
Vagina (resection rectovaginal septum)	6	
Prostate (partial or complete resection in all)	6	
Ureter (partial resection in both	2	
Abdominal parietes (wide excision)	1	
		31
Liver metastasis—1 to 5 small nodules	19	
Age—70 or above	22	
Adherence to sacrum	1	
Transplantation of colostomy to perineum with resection	10	
Transplantation of transverse colostomy to perineum with resection	1	
Adiposity	9	
Diabetes	2	
Asthma	2	
Bronchiectasis	1	
Cholelithiasis—severe (cholecystecomy performed at time of resection)	1	
Severe coronary disease	2	
Double carcinoma of rectum and sigmoid	2	
Ulcerative colitis	2	
Concurrent adenocarcinoma with inflammatory (L.V.) rectal stricture	1	
Multiple polyposis	1	
		76
		107

Invasion of regional lymph nodes determined by microscopy was observed in sixty-seven cases or 36.2 per cent. It will be noted that the nodal involvement has not been grouped. Two hundred and twenty-one of the 236 patients survived this operation—a mortality of 6.3 per cent. The cause of death in the fifteen patients was peritonitis five, pulmonary embolism three, myocardial failure two, uremia one, diabetic coma one, pneumonia one, hemolytic transfusion reaction one and anesthesia one.

Preoperative Preparation. Except in the presence of obstruction, all patients are admitted to the hospital five to seven days prior to operation. A complete examination, including cystometric studies, is made and the patient placed in fluid, caloric, nitrogen and electrolyte balance. Unless contraindicated, a minimum of 2,500 to 3,500 cc. of fluid daily is consumed. Since 29.7 per cent of our patients with rectal and sigmoidal cancer showed hypoproteinemia during the preoperative period,[15] nitrogen equilibrium is established and maintained by a low residue diet in four feedings: Carbohydrate 400 Gm., protein 120 Gm., fat 50 Gm., and amino acids (casein hydrolysate reinforced with tryptophan) 300 to 400 cc. orally each day. One or more blood transfusions are administered in quantities sufficient to raise the erythrocyte count to four and one-half million. To assist in avoiding hemolytic transfusion reactions and their sequelae, sodium bicarbonate sufficient to maintain a urinary hydrogen ion concentration above 7.0 is given. Routinely, by mouth, thiamin chloride 50 mg., nicotinamide 100 mg., ascorbic acid 100 mg., and pyridoxine 5 mg. are prescribed daily. On the third preoperative day 1,000 mg. of sodium ascorbate is prescribed and for each day thereafter until operation. On the fifth preoperative day a non-absorbable sulfonamide is begun by mouth and continued to the morning of operation. Succinylsulfathiazole is given in an initial dose of 0.5 Gm. per kilogram weight, followed by a dosage of 0.25 Gm. per kilogram every four hours. More recently, phthalysulfathiazole, a sulfonamide having a similar mode of action, has been used in 119 cases, including eighty-two proctosigmoidectomies. The initial dose is calculated on the basis of 0.1 Gm. per kilogram weight; the maintenance dose is estimated upon the same basis. Castor oil, 40 cc., is given on the evening of the second preoperative day. The following day (first preoperative), the patient receives glucose

in water every hour and amino acids to total 2,000 calories. On the morning of operation, the rectum is irrigated until clear

ment, all patients submitted to radical extirpation routinely receive 500 cc. of whole blood during the operation, and if

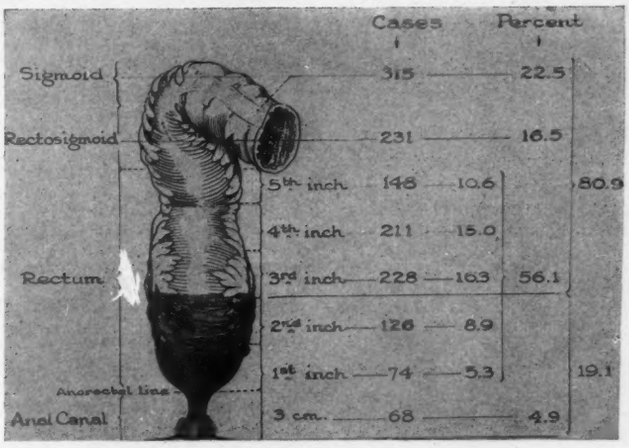

Fig. 9. Distribution of cancerous lesions occurring in the anus, rectum and sigmoid. The sphincter muscles must *not* be preserved where lower edge of growth is within 6 cm. of anal margin.

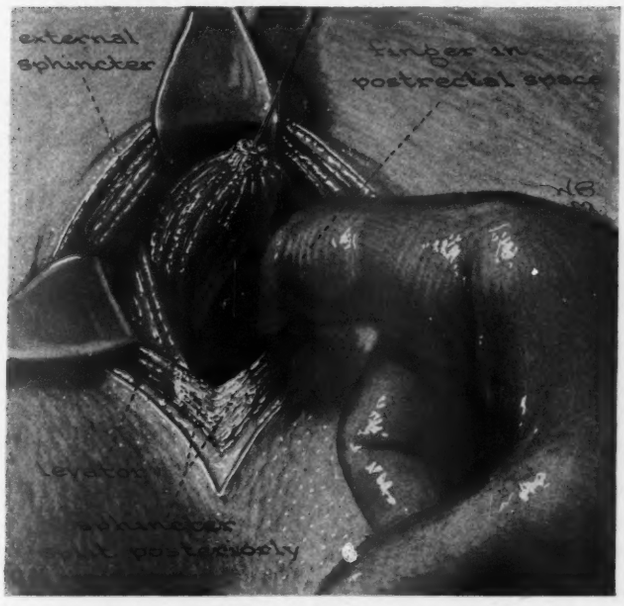

Fig. 10. Mobilization of lower rectum.

and the residuum aspirated; amino acids and glucose in physiologic saline are administered intravenously and continued during the operation with 500 cc. of whole blood. An indwelling (Foley) catheter is inserted into the bladder.

Care during Operation. Our choice of anesthesia is fractional or continuous spinal, using 0.3 per cent pontocaine in 7 per cent dextrose solution. In our department, all patients submitted to radical extirpation routinely receive 500 cc. of whole blood during the operation, and if such is not obtainable, plasma or gelatin is substituted. As can be appreciated, the circumstance of a suddenly depleted blood volume calls for immediate replenishment, and the quickest and best means to increase blood volume is by direct infusion of blood.

Operation. Abdominal Phase: The abdomen is opened through a left oblique incision 3 cm. above the inguinal ligament, beginning at a point medial to the anterior

superior iliac spine and ending to the right of the midline above the pubic spine. Ordinarily, the left anterior rectus sheath is

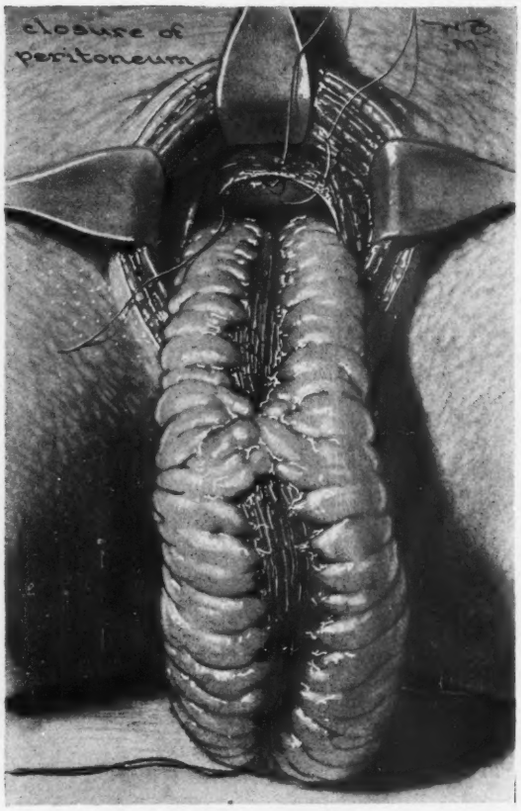

FIG. 11. Mobilization completed; anterolateral floor or pelvic diaphragm established by suture.

divided and, in a few instances, we have detached both the rectus and pyramidalis muscles from the pubic spine as suggested by Cherney.[16] The liver is examined for metastasis; the median lumbar, upper and lower mesocolic areas palpated for nodules, and the extent of the growth determined. The patient is placed in the Trendelenburg position and the pelvic cavity cleared of small intestine by hot packs. The left lateral leaf of the mesosigmoid is freely divided wide of any malignant infiltration, the incision being carried downward to the rectovesical or recto-uterine sulcus. In the course of the dissection, the left ureter, iliac and the spermatic or ovarian vessels are exposed. The spermatic or ovarian vessels may be divided and ligated. The sigmoid with attached fat and mesosigmoid is mobilized downward, continued around the right pelvic brim and across the sulcus between the rectum and bladder or uterus to meet its fellow of the opposite side.

Ordinarily, transillumination is employed to visualize the inferior mesenteric, superior hemorrhoidal and sigmoidal vessels, and their communicating arcades. By such, greater precision can be exercised of those to be preserved, which is essential for that portion of the sigmoid to reach through the perineum. The necessary vessels, namely, the superior hemorrhoidal and lower sigmoidal, are clamped, divided, and doubly ligated. If desired, the lateral peritoneal leaflet of the descending colon may be divided in order to slide the bowel to a lower position. Having determined the point of viability by observing pulsating arteries or by the character of the bleeding when the small vessels on the surface of the bowel at the level of resection are incised, it is identified with black silk. By gently inserting the hand into the postrectal cellular space in the pelvis, the lower pelvic sigmoid and rectum can be stripped from the anterior surface of the sacrum as far as the sacrococcygeal articulation. The lateral ligaments are rendered prominent and divided; they may or may not require ligation. Anteriorly, in the female, the rectum is separated from the upper portion of the vagina, and in the male from the base of the bladder as far as the prostate. Care should be exercised to avoid injury to the seminal vesicles and vas deferens. Two and one-half Gm. of sulfathiazole powder are dusted over the viscera which is covered by the great omentum and the peritoneum closed. Interrupted sutures of No. 32 gauge alloy steel wire are introduced for fascia, and No. 35 gauge for skin.

Perineal Phase: The patient is changed to the lithotomy or inverted position on the specially designed spinal mattress and the rectum packed loosely with antisepticized gauze. The anal skin is incised circularly immediately distal to the pectinate or anorectal line. The sphincter muscle is identified, separated and retracted. Usually, a single transverse incision through the fascia

propria, which is closely adherent to the periosteum of the lower border of the sacrum, is all that is needed to mobilize the rectum posteriorly. By making traction on the bowel, the levator ani muscles are placed on the stretch, providing the lateral ligaments have been divided during the abdominal phase. The levators are clamped high, severed, and ligated. Anteriorly, the superficial and deep transverse perinei muscles are retracted. Cautiously the line of cleavage between the rectum and prostate is followed until the base of the bladder and the seminal vesicles come into view. In the female, the rectovaginal septum is separated by blunt and gauze dissection until the upper portion of the posterior wall and uterus are exposed. Mobilization being complete, the rectum and lower sigmoid are drawn through the wound and enclosed in a towel. The segment of bowel identified with black silk noting viability should protrude well beyond the skin margin. An anterolateral pelvic floor is established and the perinei and anterior sphincter muscles are permitted to assume their normal position. A curved, perforated, metal drain is inserted posteriorly along the sacrum to evacuate blood and serum during the first forty-eight hours. Dressings are applied; the extruding bowel slit at point of or above viability (5 to 7 cm.) to allow for retraction, and a No. 28 gauge rubber tube placed and tied in the bowel. This rubber tube is removed after the first bowel movement, usually the third or fourth postoperative day.

Table VII

	N.	Calories	NaCl.
1,000 cc. 10% glucose in N. sal. with....	.....	400	9.0 Gm.
300 cc. Amino Acids (15% sol.).....	6.15 Gm.	180	
1,000 cc. 10% glucose in St. dist. water..	.....	400	
50 cc. Sod. Lactate in 250 cc. St. Dist. water M/6 Sol.....	.....	14	
250 cc. whole blood (average).....	8.0	200	1.1 Gm.
250 cc. Blood plasma or Lyovac.....	2.4	61.5	1.5 Gm.
40 cc. St. dist. water with 2½ Gm. Sod. Sulfathiazole.....			
3,140 cc.	16.55 Gm.	1255.5	11.6 Gm.

Postoperative Treatment. Whole blood given during the operation is followed by 5 per cent glucose in isotonic saline solution; additional blood and plasma are administered if there is any doubt as to their need. Inhalation of high concentration of oxygen is given for a minimum of twenty-four hours for the purpose of effecting a reduction in the amount of nitrogen, thereby diminishing intestinal distention. Wagensteen suction is in force during the operation to avoid vomiting and regurgitation of vomitus into the lungs, and is continued for forty-eight hours or more.

It is of utmost importance to determine the patient's status as to hydration and acid-base balance. Dryness of the skin, thirst, and capillary turgor, but especially the urinary output per twenty-four hours, vaporization from skin and lungs, comparison with preoperative fluid balance and blood studies; the plasma protein, specific gravity of blood plasma and whole blood, the cell volume of venous blood by means of the hematocrit and the McClure-Ulrich test for tissue avidity are helpful indices, while the total serum carbon dioxide content and serum chloride, the daily urinary chloride concentration, loss by perspiration, loss by duodenal suction and by the Babcock intra-abdominal sump drain, will assist in ascertaining the electrolyte status.

It must be realized that there is a period of approximately seventy-two hours following proctosigmoidectomy when parenteral administration must of necessity be employed if nitrogen equilibrium is to be maintained. In a series of 103 patients, 83 or 80.5 per cent were held in positive nitrogen balance after resection by the administration of whole blood, blood plasma, and

Fig. 12. Anterior closure is shown; curved perforated tube drain posteriorly in place. Ordinarily, the bowel is divided and the rubber tube introduced only after all sutures have been introduced and dressings applied.

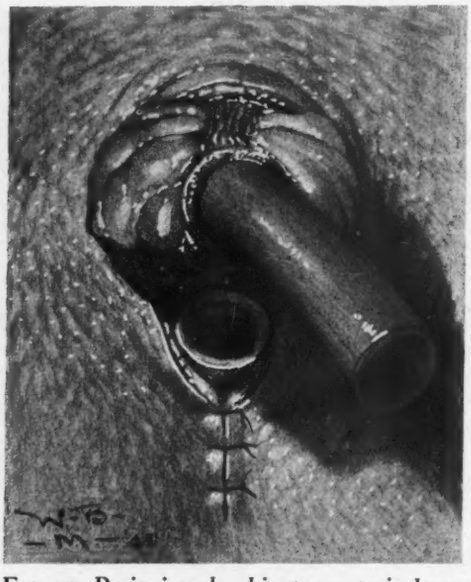

Fig. 13. Perinei and sphincter anteriorly as well as laterally are permitted to assume normal position. Divided sphincter posteriorly is not approximated immediately; 5 to 7 cm. of viable bowel are permitted to protrude from anus to allow for retraction. (We have recently found that division of sphincter muscle posteriorly is unnecessary).

Table VIII

Initials	Age	Sex	Type of Lesion	Day out of Bed	Day Discharged Following Resection
1. M. B.	66	M	Carcinoma	7	12
2. T. D.	55	M	Carcinoma	6	12
3. M. L.	59	M	Carcinoma	7	12
4. G. M.	55	M	Carcinoma	6	17
5. J. B.	48	M	Carcinoma	8	11
6. E. O.	64	M	Carcinoma	7	12
7. J. W.	57	M	Carcinoma	7	16
8. E. D.	59	F	Carcinoma	6	12
9. P. K.	55	M	Carcinoma	6	12
10. L. M.	72	M	Carcinoma	8	14
11. L. R.	52	M	Carcinoma	8	14
12. D. M.	69	F	Carcinoma	6	14
13. F. W.	62	F	Carcinoma	6	11
14. E. McR	63	M	Carcinoma	6	12
15. A. S.	70	F	Carcinoma	6	11
16. P. C.	39	M	Carcinoma	6	11
17. E. R.	42	F	Carcinoma	6	15
18. W. O.	52	M	Carcinoma	6	12
19. T. C.	38	M	Carcinoma	8	13
20. T. F.	69	M	Carcinoma	8	15
21. A. R.	72	F	Carcinoma	7	14
22. E. N.	38	F	Carcinoma	10	14
23. E. K.	68	F	Carcinoma	9	12
24. E. E.*	51	F	Carcinoma	13	19
25. J. M.	63	M	Carcinoma	8	13
26. B. M.	52	F	Carcinoma	9	13
27. M. L.	32	F	Carcinoma	9	12
28. F. T.	52	M	Carcinoma	8	13
29. G. W.	60	M	Carcinoma	9	15
30. C. B.	54	M	Carcinoma	10	17
31. A. H.	62	F	Carcinoma	9	15
32. R. F.	52	F	Carcinoma	11	21
33. G. B.	56	F	Carcinoma	10	18
34. C. R.	44	M	Carcinoma	9	12
35. S. P.	55	M	Carcinoma	8	12
36. M. M.	29	F	Carcinoma	8	11
37. V. P.	58	F	Carcinoma	10	16
38. H. S.	51	M	Carcinoma	8	15
39. A. H.	64	M	Carcinoma	9	19
40. M. M.	62	M	Carcinoma	7	12
41. M. T.	46	F	Carcinoma	7	18
42. A. S.	70	F	Carcinoma	9	20
43. G. W.	70	M	Carcinoma	9	22
44. L. D.	37	F	Stricture (L. V.)	9	13
45. M. C.	39	F	Stricture (L. V.)	10	16
46. E. G.	26	F	Stricture (L. V.)	6	14
47. L. A.	26	F	Stricture (L. V.)	6	11
48. E. M.	25	F	Stricture (L. V.)	6	10
49. B. S.†	39	F	Stricture (L. V.)	6	15
50. F. R.*	45	M	Stricture (L. V.)	6	12
51. A. V.	64	F	Carcinoma	6	11
52. J. C.	55	M	Carcinoma	6	11
53. M. R.	52	F	Carcinoma	6	11
54. S. K.	58	M	Carcinoma	6	12
55. A. McF	73	M	Carcinoma	9	18
56. S. S.	64	F	Carcinoma	6	11
57. W. H.	41	M	Carcinoma	6	11
58. W. G.	66	M	Carcinoma	6	12
59. L. K.	35	F	Carcinoma	6	11
60. L. L.	41	F	Carcinoma	6	11
61. H. T.	32	F	Carcinoma	6	11
62. A. DeG	68	M	Carcinoma	9	19
63. J. F.	45	F	Carcinoma	6	11
64. G. G.	61	F	Carcinoma	6	12
65. C. B.	61	M	Carcinoma	16	30
66. A. K.	57	F	Carcinoma	6	12
67. W. J.	35	M	Carcinoma	7	11
68. R. B.	58	M	Carcinoma	6	11
69. J. H.†	56	F	Carcinoma	7	15

Average—out of bed—7.4 days. Average—discharge after operation—13.6 days.

* Resection and transplantation of colostomy to perineum.

† Resection and transplantation of transverse colostomy to perineum.

amino acids in liberal quantities. In other words, twenty or 19.5 per cent of the cases showed hypoproteinemia; levels of 6.5 Gm. per 100 cc. or above were considered normal. In contrast, however, were seventeen patients in whom no treatment was given. Of this number fifteen or 88 per cent became hypoproteinemic. Following resection, 2,500 to 4,000 cc. of fluid are given each day during the immediate postoperative period or until the patient can tolerate sufficient quantities by mouth. The amounts and values necessary to maintain fluid, caloric, nitrogen and acid-base balance, approximate the following: 1,000 cc. of 10 per cent glucose in physiologic saline solution with 300 cc. amino acids (15 per cent solution); sodium lactate* (1–50 cc. ampule one-molar sodium lactate dissolved in 250 cc. of 10 per cent glucose in sterile distilled water represents a one-sixth molar solution and is equivalent

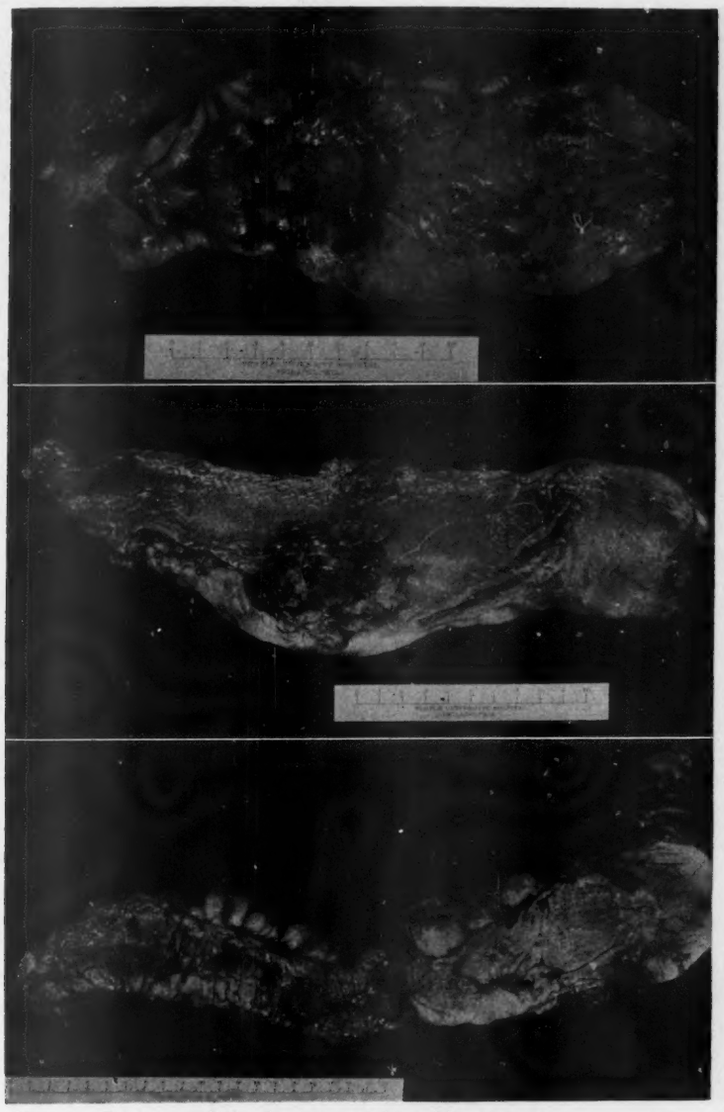

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 14. Specimen following proctosigmoidectomy.
Fig. 15. Specimen removed following proctosigmoidectomy.
Fig. 16. Multiple polyposis with superimposed malignancy; removed by abdominoperineal proctosigmoidectomy.

* The amount of sodium lactate needed is computed by daily estimation of the carbon dioxide content; e.g., Kilogram weight of patient × CO_2 deficit (65 vol. per cent accepted as normal) × 0.026 = the amount of $NaHCO_3$ in Gm.

to 8.4 Gm. sodium bicarbonate); sodium sulfathiazole, 2½ Gm. twice daily dissolved in 40 cc. of sterile distilled water;

Fig. 17. Specimen removed by proctosigmoidectomy.

blood plasma or Lyovac, 250 cc. daily, whole blood 500 cc. on first and third postoperative day.

Modern chemotherapeusis has been of value in preventing and combatting infection, especially peritonitis. Patients are given sodium sulfathiazole 2½ Gm. twice daily beginning the morning following operation. Guides are the urinary output, the blood sulfathiazole level, and the number of erythrocytes in the urine. Succinylsulfathiazole is given in suspension in the same dosage as before operation, namely, 0.25 Gm. per kilogram body weight every four hours as soon as the patient is able to tolerate liquids by mouth, usually on the third or fourth postoperative day. Phthalylsulfathiazole has been employed more recently. The drug is given postoperatively in amounts equal to the preoperative dose, namely, 0.1 Gm. per kilogram body weight every four hours in suspension as soon as liquids are tolerated by mouth. A definite decrease quantitatively of the coliform organisms has been noted by stool culture. In no instance have we encountered any untoward reaction.

Abdominal wound infection and dehiscence have been infrequent complications, in fact, in this series of 236 cases there were only two instances of abdominal wound infection 0.85 per cent. To a great measure, we believe that this has been due to the use of sulfonamides, to the maintenance of adequate protein and vitamin C levels, to the employment of the oblique muscle splitting incision and Babcock's alloy steel wire.[12]

Patients following proctosigmoidectomy are permitted out of bed usually on the sixth day, and during the past eighteen months the majority have been discharged from the hospital on the eleventh or twelfth postoperative day. It is worthy of mention that the presacral wound consumes about three weeks for complete healing and closure, approximately that of an ordinary anorectal fistula. Thus, the majority of our recent cases have been able to return to their former or perhaps lighter occupations in an average of six to ten weeks following operation. In our other types of abdominoperineal extirpations, in which a large perineal wound is made, at least three months was the average period required for healing.

It is rather difficult to estimate accurately the date of discharge especially with patients referred from distant cities who remain until transportation facilities are obtained or for similar reasons. Table VIII shows the day the patient is permitted out of bed and the day of discharge in a

recent group of patients in whom an abdominoperineal proctosigmoidectomy was performed.

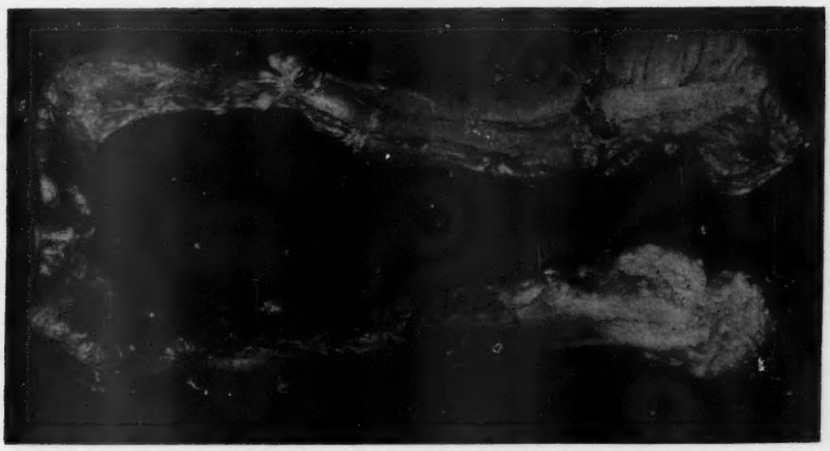

Fig. 18. Specimen removed by proctosigmoidectomy and hemicolectomy. The transverse colon was transplanted to the perineum and sphincter muscles preserved. No. 49 in Table VIII out of bed on the sixth day.

Improvements and refinements in technic, such as establishment of an anterolateral pelvic floor, have prevented descent of small bowel into the perineal wound; precise maintenance of essential blood supply has avoided retraction and necrosis, and preservation of the sphincter musculature has offered continence in approximately 95 per cent of cases. Between 90 and 95 per cent are able to carry out their daily occupations without inconvenience. If one may judge from those patients in whom an abdominal colostomy was transplanted to the perineum, a perineal anus or anal sigmoidostomy is a distinct improvement over even a well constructed stoma in the abdomen.

Besides manometric methods for muscle contraction which is now being employed in our department, one means to evaluate the status of a perineal anus is to compare it with an abdominal colostomy in patients who have had both. To date, Babcock and the writer on their respective services have transplanted the abdominal colostomy to the perineum with or without resection in 84 cases with but one death (1.2 per cent mortality). These patients attest that they are more pleased, that the discharge of offensive gas is much less evident, that the perineal opening is more convenient and easier to care for and that evacuations are more satisfactory and less frequent.

SUMMARY AND CONCLUSION

An experience of five years in a group of 461 cases of cancer of the anus, rectum and pelvic colon has been reviewed. An operability rate of 91.9 per cent and a resectability rate of 80.4 per cent are cited. Based on a series of cases as to location of growth, it may be deduced that in over 80 per cent of cancer in these parts, the sphincter musculature may be preserved. It will be noted that of the 371 resections, 262 or 70.6 per cent were performed without an abdominal colostomy and of this number, the technic of "proctosigmoidectomy" was employed in 236 or 63 per cent. The writer is convinced that this procedure has a definite place in the armamentarium toward combatting malignant disease. It permits radical removal of the cancerous bowel and gland-bearing areas and in spite of a high rate of resectability enjoys a low mortality rate (6.3 per cent in 236 cases); it allows early discharge of the patient from the hospital, reduces the period of wound healing, and affords early return to work.

It will be noted that following operation 80.5 per cent of the patients were held in positive nitrogen balance by the administration of whole blood, blood plasma and amino acids in liberal quantities. The use

of parenteral sodium lactate has proved helpful in protecting against renal complications from parenteral administration of absorbable sulfonamides. While peritonitis is the chief cause of death, non-absorbable sulfonamides, namely, succinylsulfathiazole and phthalylsulfathiazole, appear to have reduced the incidence. We have found that the customary three days for administration of these drugs is inadequate and recommend six days prior to operation given in dosage according to the kilogram weight of the patient.

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TRAUMATIC ANEURYSMS OF THE EXTREMITIES*

COMMANDER GERALD H. PRATT
MEDICAL CORPS (S), UNITED STATES NAVAL RESERVE

IN 1941 and 1942 the author reported on the surgical treatment of peripheral aneurysm. Since that time while on duty with the U. S. Navy, fifteen more aneurysms, all of traumatic origin, have been surgically treated. All but two of this last group originated in combat. In peacetime as well, many aneurysms will arise from trauma, incident to auto and airplane travel resulting in injuries to major vessels. Those originating from gunshot and stabs of either accidental or criminal cause will continue. Hunting seasons give a proportionate increase in the numbers of these patients appearing for surgical treatment. The degenerating diseases such as syphilis and arteriosclerosis, while not of concern in this paper, are predisposing causes which trauma may precipitate. In such patients healing after trauma is delayed or is incomplete with the aneurysm as a result.

The traumatic aneurysm may be arterial or arteriovenous in type. Its origin usually is due to an incomplete severence of a major artery with the development of a pulsating hematoma and later a false sac. More rarely, complete severence not litigated or insecurely tied may cause the aneurysm, and in grossly infected wounds, slough above the site of a ligated vessel may result in leakage, clot development and eventual aneurysm formation. When the vein is involved in the injury, an arteriovenous fistula occurs. Attempts to differentiate between an aneurysm and a pulsating hematoma have been made, some observers reserving the former term for a well organized sac, whether of the so-called true or false type. The difference is merely in the length of time the pathological process has been going on, as the pulsating clot surrounding a lacerated vessel will eventually develop a thickened sac and wall, provided it does not rupture first. In one recent article, it was stated that since many of these conditions subside spontaneously, operation should be reserved only for those which persist. With this we cannot agree. While occasionally a sufficiently thick wall may develop to obliterate the pulsation, one must remember that a fundamental characteristic of any aneurysm is to enlarge despite all surrounding structures. The aneurysmal erosion even of vertebrae is not unusual, and is an example of this characteristic.

While some aneurysms may develop directly after the injury, there may be a latent period while a clot temporarily occludes the laceration. After a time, from two weeks to six weeks, liquifaction of the clot occurs with a local hemorrhage, arrested by the surrounding muscles or fascia. Repeated episodes of bleeding occur with enlargement of the mass and the gradual development of a wall or sac made by the surrounding tissue. Clots laminate, organized and fibrose leading to a tumor mass. This mass will be expansile and pulsating depending on its size, the character of the surrounding walls, and the amount of liquid core. Other symptoms depend on whether the lesion is arterial or arteriovenous, and on its size and site.

In the *arteriovenous* type of aneurysm, if large and persistant, certain physiological changes occur. These are: (1) A fall in arterial pressure with a gradual recovery, the systolic pressure being higher and the diastolic lower, thus a greater pulse pressure; (2) an increase in the venous pressure;

* Released for publication by the Bureau of Medicine and Surgery, Navy Department. The opinions and views set forth in this article are those of the writer and are not to be considered as reflecting the policies of the Navy Department.

(3) an increase in the pulse rate; (4) an increase in cardiac output, depending on the site and size of the fistula; (5) tem-

FIG. 1. Arteriovenous popliteal aneurysm. Note enlargement of leg and intense collateral circulation development.

porary decrease in size of heart followed by an increase and hypertrophy of the heart; (6) increase in total blood volume; (7) development of collateral circulation around the fistula; and (8) if continued, cardiac failure.

Points six and seven are of therapeutic value, the operation being postponed, when this is feasible, until the collateral circulation is complete (three to six months) and in the large fistulas a phlebotery aids in reducing the increased blood volume at the time of the operation, and thus reduces the immediate cardiac load. Analysis of the venous blood will show higher oxygen content in the fistulous vein than in other veins. These veins are usually dilated. Pain depends on pressure on the nerves or sensitive parts.

In the *arterial aneurysms* there may be partial arterial failure distal to the aneurysm with diminished or absent peripheral arterial pulsations and decreased oscillometric readings. There may be weakness in the part, blueness and coldness. A tumor with thrill and bruit vary with the site and size of the aneurysm. Pain in all aneurysms depends on pressure of the sac on nerves or sensitive tissues, or on arterial failure to the part.

Operative treatment should be directed towards eliminating the aneurysm without interfering with the necessary collateral circulation. This may be done in one of the following ways:

1. In small aneurysms at times excision with end-to-end anastomosis of the vessel is feasible. By rerouting the vessel and flexing joints, a defect of 5 to 7 cm. can be bridged. This procedure was followed in one recent instance in the radial artery, with success.

2. A vein transplant occasionally can be used to bridge an arterial defect. If successful, the vein wall thickens, and in one examined some years later it was difficult to differentiate the vein from the artery.

3. In the arterial aneurysms, obliteration of the sac without its excision is the treatment of choice. After controlling the circulation above and below, the sac is incised, the contents evacuated, collateral openings into it sutured and the sac itself obliterated by implanting a contiguous muscle. In the popliteal area a section of the biceps or semi-membranosis can be utilized readily. The pectoralis major serves well in the axillary artery aneurysms. The sac retention prevents the division of the collateral vessels running near or in its wall. This fundamental surgical principle was originally demonstrated by Dr. Matas. Excision of the sac is the cause for most of the amputations in peripheral arterial aneurysms.

4. In a few of the arterial and in all arteriovenous types, the sac must be excised. All vessels entering the sac, arterial or venous, are resected and ligated with transfixion sutures. The sac is then excised. Retention of the sac in the arterio-

venous type may permit recurrence by leaving some small vessel continuity.

In all events, when the arterial circulation is divided, the accompanying vein, too, should be resected. There is 12 per cent less incidence of gangrene after ligation of the iliac artery if the accompanying vein also is sectioned.

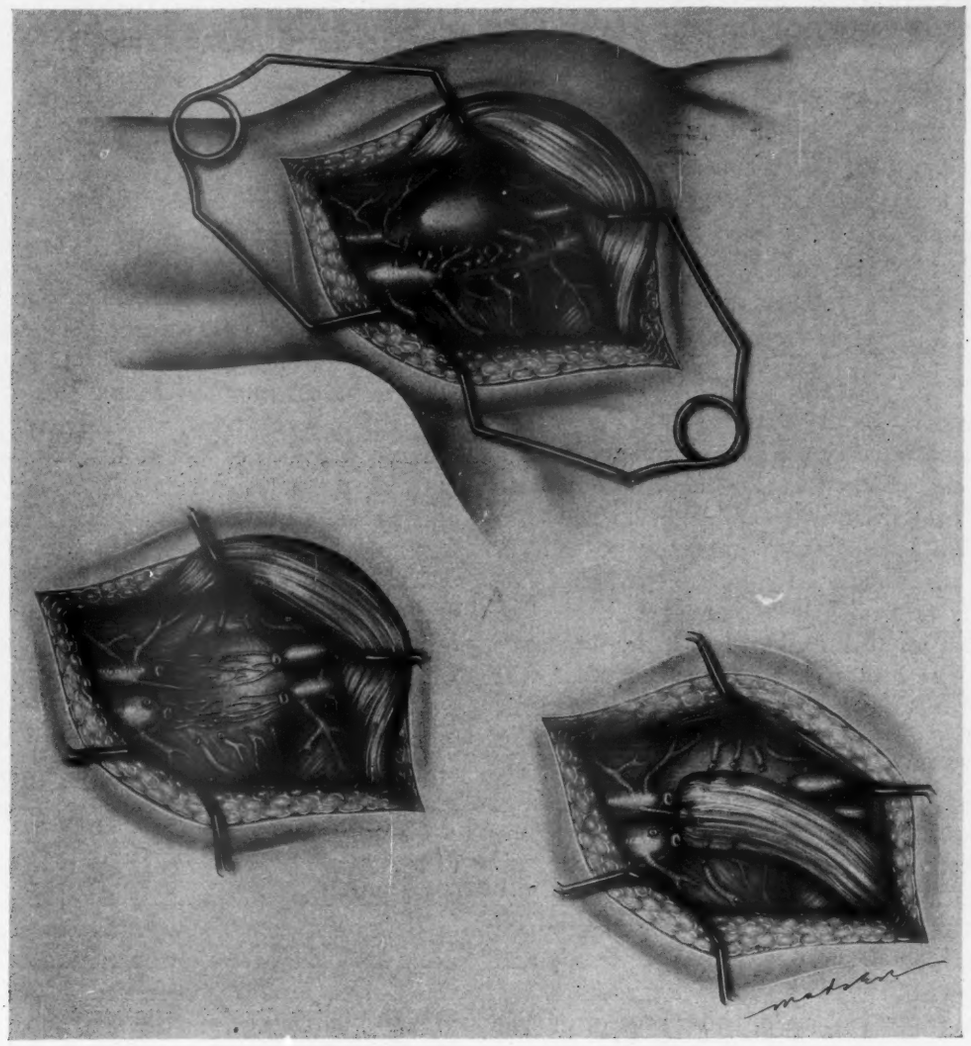

FIG. 2. Arteriovenous aneurysm; axillary artery; innumerable collaterals; excision of sac and muscle implant.

AFTER-CARE

In all operations of this type repeated sympathetic nerve blocks are indicated and may save the limb, as the collateral circulation goes into a spasm at times. In some a sympathectomy is necessary to continue the block effect indefinitely. Where plastic operation on the artery has been done, the anti-coagulants heparin and dicoumarol are necessary, and should be continued until the outcome is no longer in doubt. The bleeding time should be maintained at or above fifteen minutes, and the prothrombin time (diluted) kept twice normal. Pressure areas should be prevented. A slight lowering of the foot of bed is favorable for the questionable circulation unless there is excessive edema. The question of warm or cold after operation is still debatable. An optimal temperature of 100° to 105°F. has been considered best to reduce collateral circulation spasm. The recent work on refrigeration has

caused many to use a cold cradle after operations on the theory that chilling reduces the oxidation of the extremity and thus it demands for blood supply. At present we use the warm cradle unless it is apparent that circulation cannot be restored.

Five patients with aneurysms were treated on one sixteen-day voyage on a U.S.N. Hospital Ship (U.S.S. Relief) in 1944 in the Pacific. These patients were brought aboard at New Calodonia for evacuation to the U.S.A., and were casualties from the battles of Pellelieu and Saipan. A brief review of their course is given:

Case I. A twenty-two year old Army private had been shot by a Japanese machine gun twenty days before at Pellelieu. The wound was a through-and-through one in the left thigh with the point of entrance posteriorly three inches above the popliteal space and exit anteriorly at a slightly higher level. There had been occasional bleeding from the entrance wound. The foot was cool, and no pulse was felt in the dorsalis pedis or posterior tibial artery. On the first night aboard, the patient awakened to find his bed wet with blood. He called the nurse who saw no active bleeding, but before the medical officer arrived, a violent hemorrhage occurred, uncontrolled by a tourniquet applied immediately above the wound. A second tourniquet below the wound stopped the bleeding. Transfusions were ordered, and the patient taken to the operating room.

At the operation, a sloughing area of muscle and fascia was cleared away disclosing a partly divided femoral artery, with old and new clots surrounding it. Resection of the vessel had to be done some distance proximal and distal due to the necrosis. The clots were removed, the accompanying vein resected and the wound closed with implantation of the semi-membranosis muscle in the sac defect. A sympathetic nerve block with procaine was done at once. and repeated at six- to eight-hour intervals for thirty-eight hours. The circulation, while embarrassed, re-established itself and the wound healed primarily.

Case II. An eighteen-year old private in the Marine Corps had a through-and-through wound of the thigh with a pulsating hematoma visible and palpable near the point of exit, and a tumor the size of a grapefruit. Exploration with evacuation of the clot and obliteration of the aneurysmal sac was done utilizing the adductor muscle group to close the sac. Imbrication sutures of silk were used. The circulation was re-established. Hemorrhage on the operating table was controlled only with digital pressure.

Case III. A twenty-year old Corporal of the Marines was admitted with a diagnosis of multiple wounds. The right leg had been amputated eight inches above the knee by a guillotine type of procedure, with partial skin closure by two or three sutures. On the third day aboard, there was slight hemorrhage from the stump, and a pulsation of the expansile type was noticed. Shortly thereafter, a massive hemorrhage occurred controlled after the loss of a large amount of blood by tourniquet and manual pressure. The patient was operated on at once and a slough above the site of the femoral artery ligature was found to be the site of the bleeding. Because of the slough, the hemorrhage was controlled only by the insertion of a finger at the artery opening while dissection was continued to where there was normal vessel wall. The wound was then lightly drawn together. This stump healed rapidly thereafter, and the patient was on crutches when the ship reached the U.S.A.

Case IV. A twenty-eight year old Corporal of the Army was admitted for transfer with a diagnosis of wounds, multiple, shrapnel received on Saipan. Among the wounds was one near the groin and on examination a pulsating tumor was noted. This was observed to be increasing in size slightly and on the sixth day at sea an operation was performed. The artery and vein were found involved in the aneurysm. The sac was the size of a lemon, and surrounding it were innumerable vessels connecting with it and with each other. These vessels could not be identified as either veins or arteries. They were obviously very immature, developing as collateral circulation, and bled on the least trauma.

Each vessel was ligated as it was encountered. Even with rubber tube control of the major vessels, frequent hemorrhage occurred during the procedure. Some of the vessels consisted of only a very thin layer and tore on any traction. The sac was excised with the tributory vessels. As in the others, sympathetic nerve blocks were

performed. The foot, at the completion of the operation was cyanotic, cold and appeared lost. The sympathetic nerve blocks were most effective in this patient, as after each one the circulation visibly improved. This patient was on crutches when the ship reached San Francisco.

Case v. The last patient, a Marine private, also had the diagnosis of wounds, multiple, shrapnel received at Pellelieu. One leg had been amputated above the knee on the beach, and there were multiple wounds in the other leg. The high incidence of aneurysms caused a careful search for others, and this one was found only accidentally. It arose from the femoral artery of the unamputated leg and was expansile, and was approximately the size of an egg. There was a sinus leading to a shrapnel wound from which serous drainage exuded. Operation was performed electively as it appeared likely hemorrhage would occur. Both the femoral artery and vein were involved in the sac, and the sac, many collateral vessels, and a large section of the artery and vein were resected. With nerve blocks the peripheral circulation returned well, and a feeble pulse in the dorsalis pedis could be felt.

COMMENT

The occurrence of five aneurysms in a shipload of approximately 450 wounded was unusual, but an incidence of 1 per cent probably exists in traumatic wounds of the extremities caused by gunshot or stabs. The tendency to massive hemorrhage is characteristic, and in itself is an indication for operation. Where possible, the operation should be postponed for three to six months to permit adequate collateral circulation to develop, but where the wound is open or infected, delay is dangerous. Operation in such instance should be performed at the earliest facility where adequate instruments and surgical personnel are available. Two tourniquets should accompany transportation of such patients, and should be applied in event of severe bleeding above and below the site of bleeding. The sympathetic nerve blocks are an important part of the therapy, and may be the difference between success and failure in the surgical treatment.

After operative recovery, these patients should be treated like those with obliterative arterial disease, with emphasis on the developments of collateral circulation and care to prevent injury or infection of the part. These measures, briefly, are the abstinence from tobacco or other vasoconstricting drugs, use of sitz baths, avoidance of over-use of the limbs to prevent arterial supply failure, and the use of vasodilators such as whiskey and papaverine. Very careful foot hygiene with nail care is necessary, with prevention of skin breaks due to fungus infection, blisters or corns or inadequate-sized shoes and socks.

The operations described have been performed on fifteen patients since entering the Naval Service. In addition, I performed forty-two previous operations of similar nature. Since then 5 more operations have been successfully completed. In these sixty-two patients, no limb has been lost, although in one early operation for arteriosclerotic aneurysm, one little toe became gangrenous.

SUMMARY

1. Observations in arterial and arteriovenous aneurysms are presented.

2. A synopsis of five patients on whom operations were performed at sea on a U.S.N. Hospital Ship is given.

3. Surgical operations are discussed.

4. After-care is specified.

GENITAL TUBERCULOSIS IN WOMEN

ARCHIBALD L. McDONALD, M.D.
Attending Surgeon, St. Luke's and St. Mary's Hospitals
DULUTH, MINNESOTA

THE literature on this subject presents two constant and significant features. Most articles begin by stating the condition is a rare one, and then proceed to prove it is much more common than usually supposed. It appears the correct clinical diagnosis is rarely made, till the pathological specimen is examined microscopically in the laboratory. Greenburg,[1] in a review of 200 proven cases at the Johns Hopkins Hospital, gives the frequency as follows: 1 per cent of all gynecological cases, 8 per cent of all pathological Fallopian tubes, and one in thirteen cases diagnosed clinically as chronic pelvic inflammatory disease. The correct preoperative diagnosis was made in only 13 per cent of the series, and one-half of these had ascites and obvious tubercular peritonitis. Lahmann and Schwartz[2] studied twenty-one proven cases. In none of these was the correct diagnosis made or even considered prior to surgery, and in only one before examination on the specimen in the laboratory.

Obviously, the clinical picture is not sufficiently characteristic, nor sufficiently recognized to permit accurate clinical diagnosis, even by experienced clinicians. The writer's personal experience has been much the same. In a number of instances in which specimens had been sent to the laboratory with a pre- and postoperative diagnosis of chronic salpingitis or ovarian cyst, the surprising and humiliating report of tubercular salpingitis was returned. In a few cases this was of serious concern to the welfare of the patient. Three are of special interest:

CASE REPORTS

CASE 1. Mrs. B. W., aged twenty-three seen in the office March, 1942. She complained of severe pain in the lower right quadrant and of nodules on both legs. She was married at seventeen and had one normal full-term pregnancy, followed by vaginal discharge which cleared after office treatments. She had undergone sanatarium treatment for pulmonary tuberculosis and was discharged as arrested four years ago. Since then she has been well and active, menstruation regular and normal. A recent check up and *x*-ray study at the sanatarium gave negative findings. The genera-examination was negative; there was no evil dence of fluid or masses in the abdomen.

On bi-manual examination a tender mass could be palpated in the right adnexa, apparently an ovarian cyst which had prolapsed behind the uterus. One did not get the impression of inflammatory disease and the diagnosis of tuberculosis was not considered in spite of the nodules on the legs which were recognized as erythema nodosum. Pulse, temperature and leucocytes were normal, and elective surgery was arranged. On exploration the upper abdomen was normal. In the pelvis the uterus was somewhat enlarged and on each side was found an inflammatory mass including the Fallopian tube and ovary with numerous typical tubercles on the surface, which gave us the correct diagnosis. There were no adhesions to bowel, bladder or omentum. It was possible to elevate the masses and to remove the entire focus of disease including both adnexal masses with the supracervical part of the uterus *en bloc*. There was no spill of contents or injury to other structures and the wound was closed without drainage. Hospital convalescence was afebrile and uncomplicated. The patient was advised to return to the sanatarium for observation. She was discharged after a few weeks of uneventful convalescence, and has since been carrying on her household duties.

In retrospect tuberculosis of the uterine adnexa should have been considered preoperatively. However, it is a question if this would have contributed to the welfare of

the patient. Such a suspicion would have introduced the idea of palliative measures and she would have continued to harbor a secondary focus of the disease with untoward possibilities. We were able to apply adequate therapeutic measures, fortunately at a favorable stage of the disease, namely, complete removal of the focus of infection. I can think of no other course of procedure which could have accomplished as much for the future welfare of this patient.

Case II illustrates what may be accomplished under less favorable conditions. Miss A. B. aged twenty-five was referred by Nopeming Sanatarium because of recurrent abdominal pain and persistent distress. At that time the pulmonary diseases was arrested but the patient was incapacitated because of the abdominal condition. The appendix and right Fallopian tube had been removed ten years previously. At surgery the stump of the Fallopian tube was removed and also a chronically inflamed left tube with the cornua of the uterus, and the uterus was suspended. Convalescence was uncomplicated. The pathological report was tubercular salpingitis. This patient has since been under intermittent observation, and now fifteen years later is employed in defense work.

However, there is a reverse side to the picture, exemplified by Case III. Mrs. O. O. B., aged thirty-four, first came to surgery in 1926 with a diagnosis of chronic salpingitis. Both tubes were removed and convalescence was uncomplicated. There was no mention of tuberculosis by the surgeon or pathologist. She was seen in October, 1927, because of recurrent pelvic pain and distress. There was a tender mass in the right adnexa and the impression gained was that of an ovarian cyst. At surgery the omentum was adherent to the ovarian cyst which was excised. There was no excess fluid in the abdomen, and the wound was closed without drainage. Convalescence was complicated first by an apparent massive collapse of the lung, and later by a femoral thrombosis. The patient was discharged apparently in good condition, but within a few weeks there was recurrence of abdominal distress, rapid deterioration and death. Autopsy disclosed diffuse abdominal tuberculosis and generalized miliary tuberculosis.

Evidently the lesion had been attacked at an unfavorable stage and had been inadequately handled. We had failed to recognize the local tuberculosis as such, and to exclude the presence of the disease elsewhere in the body. Accordingly, we undertook major surgery under general anesthesia in an individual already allergic or susceptible to traumatic spread of the disease. Furthermore, since we did not recognize the nature of the lesion, it was incompletely removed and local spread of the process was stimulated. While there may be a proper time and method of surgical treatment, there are also improper times and equally improper methods. There is need of more accurate information concerning these lesions and the criteria of safe and adequate therapy.

During the past fifty years, a rich and extensive literature on this subject has been developed. It is neither possible or proper to present a complete review of this material. The purpose of this presentation is to develop and offer the logical conclusions therefrom which will suggest essential principles governing the conduct of such cases.

Tuberculosis of the female genital organs is but a part or complication of a constitutional disease with the primary focus in the lungs. While theoretically possible, primary involvement of the cervix or lower genital tract is so rare that this form of the disease may be practically disregarded. The infection is carried in the blood to the mucosa of the Fallopian tubes which is the primary pelvic or peritoneal lesion. The only exception is in rare instances of intestinal tuberculosis which spread by continuity to the peritoneum and Fallopian tubes.

The primary pelvic lesion in the mucosa of the tubes undergoes the characteristic tuberculous processes: tubercle formation, caseation, necrosis and encapsulation, or spread in the lymphatics.

Extension takes place into the fundus of the uterus and to the opposite tube, the condition found in most specimens studied in the laboratory. This is the status by the

time the condition is evident clinically and therefore may be considered as the minimum of pathology to be treated. Involvement of the cervix and lower tract occurs by extension from the fundus but is a late and relatively infrequent occurrence. For practical purposes it must be assumed that involvement of these structures is accompanied by lesions in the fundus and tubes. Conversely, if the cervix is clear on inspection, subtotal hysterectomy will effectively remove the pelvic lesion. The process may extend by destruction and invasion through the wall of the Fallopian tube to the pelvic peritoneum, being the most frequent source of tuberculous peritonitis in the female. Furthermore, it has long been recognized that surgical cure of tuberculous peritonitis is possible, and only possible, by complete excision of the primary pelvic focus in the fundus and tubes.

Tuberculosis of the pelvic structures occurs in a large percentage of women with advanced pulmonary lesions. Most of these are of only academic interest and present no therapeutic problem. Also, and most important, it occurs as a late complication in women who have recovered from the pulmonary lesion, and in those who present no clinical evidence of the original process. In such individuals it is often the only active focus of tuberculosis in the body. Its successful excision is practically possible by adequate surgery and will be of real service to the patient. On the other hand, unsuspected presence of pulmonary lesions, or active sensitization to the disease, may impose forbidding obstacles to successful surgical attack.

Clinically, the condition may present one of several pictures: Advanced with peritonitis, ascites and constitutional reaction which suggest tuberculosis, but with no evidence of pulmonary disease. For this condition, Hegar, in 1886, demonstrated successful results by radical surgery. In 1890, Osler[3] discussed the advantages and limitations of surgery in treatment of pelvic and peritoneal tuberculosis. Howard Kelly[4] reported successful results in a few cases. Later J. B. Murphy[5,6] presented his exhaustive study of pelvic tuberculosis and W. J. Mayo[7] made several contributions advocating adequate surgical treatment of tuberculosis peritonitis. As long as forty years ago, the possibilities and limitations of surgical treatment for this type of pelvic tuberculosis had been well formulated and accepted. In this type of disease the clinical picture is usually sufficiently clear to permit preoperative diagnosis and deliberate choice of treatment.

The less advanced stages of the disease present no characteristic symptoms or signs, and the condition is usually unsuspected till the surgical specimen is studied microscopically. The exhaustive mongraph of J. Whitridge Williams[8] is the basis for our information on this subject. Numerous subsequent studies have confirmed his findings and all together give us the picture of these lesions.

One type of the disease gives rise to chronic inflammatory changes in the Fallopian tube and adnexa, resulting in masses of varying size which may be mistaken for pelvic tumors. There is no febrile reaction or severe local tenderness so the clinical diagnosis is likely to be some type of pelvic tumor or chronic pelvic inflammatory disease at a quiescent stage. There is nothing to suggest tuberculosis, unless one thinks of it and deliberately seeks for suggestive evidence. A positive skin reaction is proof only of a lesion somewhere in the body. History or previous pulmonary tuberculosis or exposure should arouse suspicion. Early in the course of the process the endometrium of the fundus is involved and study of curretage specimen may give the diagnosis.

In other individuals, the tuberculous process is quite inactive but is found accompanying some other obvious lesion, fibroid, ovarian cyst, etc. Such involvement is discovered only at laporotomy, or more often by the pathologist when the specimen is examined in the laboratory. In a few instances the untoward effects of anesthesia or of surgical trauma will be sufficient to

cause exaccerbation of such a quiescent process with widespread dissemination of the disease.

From the available evidence one must conclude that tuberculosis of the female genital organs should be considered in the clinical diagnosis of pelvic disease as presented to the surgeon, since it is found in from 2 to 8 per cent of all such pathological specimens. This is important (1) to avoid surgery at an unfavorable time or in the presence of unrecognized pulmonary disease; (2) so that the surgeon may recognize the nature of the lesion and carry out adequate measures, namely, the removal of all diseased tissue.

Numerous reports in the literature give abundant proof that under favorable conditions such lesions may be attacked surgically without undue risk. The early reports of Hegar followed by those of Osler, Kelly, and Williams established the possibilities of surgical treatment and were soon supported by the studies of Murphy and W. J. Mayo. More recent reports by Ruben Peterson[11] Greenburg[1] and Haas[13] demonstrated the efficacy and safety of suitable surgery in this type of disease. With proper preoperative study and screening to eliminate cases with unfavorable complications, the surgical risk is not greater than for elective procedures in women of similar age except for certain contingencies: (1) The tuberculous lesion may be adherent to the bowel or bladder and careless handling may cause a fistula. (2) Drainage is to be avoided since secondary infection may result in a persistent sinus. (3) Incomplete excision of the tuberculous lesion will leave a focus for spread of the disease and exaccerbation of the process.

In this connection, one must remember that the pelvic lesion involves both tubes and the fundus of the uterus. The cervix is involved late in the process, likewise the ovaries. Therefore, adequate excision should include subtotal hysterectomy with both tubes unless the cervix is known to be involved. If the ovaries are grossly normal, they may be left at the discretion of the surgeon.

CONCLUSION

1. Tuberculosis as a cause or complication of pelvic disease must be given serious consideration in the clinical study of women patients.

2. Tuberculous peritonitis is usually due to lesions in the Fallopian tubes and can be cured by removal of the pelvic focus of disease.

3. This includes the fundus of the uterus and both tubes, all of which must be removed.

4. After surgery these patients should be kept under expert observation to detect any possible recurrence of the pulmonary disease.

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BILATERAL PETIT'S HERNIA AND AN ANTERIOR SACRAL MENINGOCELE OCCURRING IN THE SAME PATIENT

F. MILES FLICKINGER, M.D. AND JAMES C. MASSON, M.D.
Fellow in Surgery, Mayo Foundation — Division of Surgery, Mayo Clinic
ROCHESTER, MINNESOTA

THE case which we are presenting is of interest for a number of reasons. The patient was a woman who displayed bilateral congenital Petit's hernia and had in addition a large pelvic menigocele. Both lesions proved amenable to surgical intervention. Repair of the huge Petit hernia on the right side was accomplished with the use of sutures of fascia lata; the meningocele had been removed at an earlier abdominal operation.

Hernia occurring in the lumbar region may present through Petit's triangle or the Grynfeltt-Lesshaft triangle. More rarely there have been described hernias through Hartmann's cleft or through the hiatus of the lumbar spinal nerves as reported by Braun.

The inferior lumbar triangle had been described by Garengeot in 1731 and by others prior to Petit. Petit, in 1733 or 1738, reported a strangulated hernia presenting through this anatomic triangle, which has since been known as Petit's triangle. The boundaries of this triangle are the iliac crest below, the latissimus dorsi muscle posteriorly and the external oblique muscle anteriorly. The floor of the triangle is composed of the lumbar fascia overlying the internal oblique muscle, beneath which lies the transverus abdominis muscle. Watson found the normal reported height of the triangle to range from 1 to 7 cm. and the width across the base to vary from complete absence to 6 cm. Lesshaft dissected 108 adult and thirty-five infant cadavers. He found Petit's triangle to be present in 77 per cent of the adult and in 25 per cent of the infant cadavers. Goodman and Speese found Petit's triangle to be present in 63 per cent of their seventy-six dissections.

Petit's triangle is not to be confused with the superior lumbar triangle described by Grynfeltt in 1866 and Lesshaft in 1870. The latter triangle lies above and anterior to Petit's, and its boundaries are the twelfth rib and a portion of the lower border of the serratus posterior inferior muscle for a base, the edge of the internal oblique muscle for the anterior border and the edge of the sacrospinalis muscles for the posterior border. The latissimus dorsi muscle serves as a roof while the transversus abdominis muscle and fascia form the floor of the triangle.

INCIDENCE AND ETIOLOGY

Up to 1902 von Baracz could find but sixty-eight records of true lumbar hernia and only three of these stated the exact anatomic site. In 1924, Watson made an exhaustive review of the subject and found 115 lumbar hernias reported in the literature; of these thirty each were recorded to have occurred through Petit's and Grynfeltt's triangles. Watson found the following statistics for the entire group of 115: the age of patients ranged from two to eighty years, half of them being less than fifty years of age; the ratio of male to female patients was 2.7:1. He found that Petit's hernia presented predominantly on the left side in a ratio of 2.5:1, being bilateral in only one case. The 115 cases could be classified on an etiologic basis as follows: congenital (eighteen cases) 15.7 per cent, spontaneously acquired (sixty-five) 56.5 per cent, acquired traumatic (twenty) 17.4 per cent and unknown (twelve) 10.4

TABLE I

PETIT'S HERNIA: SURGICAL CASES

Author	Patient		Side	Size of Defect	Cause of Hernia	Symptoms	Repair
	Sex	Age Yrs.					
Owen 1888...	F	5½	L	Admits thumb	Lumbar abscess	.....	Inverted sac; catgut repair of muscles
Bull 1894*...	..	1¾	...	Admits thumb	Congenital?	.....	Excised sac; kangaroo tendon for deep structures
Raymond 1897	M	35	L	One finger-breadth	Wound in side	.....	Sutured latissimus dorsi to external oblique
Jones 1902...	M	45	R	.....	Old scar present	Pain; constipation	Silkworm gut in latissimus dorsi and external oblique
Lejars 1905...	M	65	L	Sac 7 cm. in diameter	.....	Pain; constipation	Excised sac; 3 sutures to close edge of muscular ring
Dowd 1907...	M	3½	R	Larger than palm	Congenital	.....	Excised sac; gluteus maximus and medius flap over defect
Medical Division of Prussian Ministry of War[24,27] 1913.	..	....	...	.....	.....	.....	No sac; sutured latissimus dorsi to external oblique
Rishmiller 1917	M	36	L	.....	Chip fracture of crest of ilium	Soreness; interfered with defecation	No sac; flap split from aponeurosis of latissimus dorsi
Turner 1917..	M	55	L	Two finger-breadths	Fall	Pain in loin	No sac; mattress sutures in muscle (penetrated bowel)
Hancock 1920	M	40	L	.....	Fall	.....	Sutured external oblique to latissimus dorsi muscles
Maidagan 1922*	F	13	L	Two finger-breadths	Abscess	.....	Excised sac; sutured latissimus dorsi to external oblique
Sias 1937.....	M	27	L	Hernia size of pigeon egg	Followed jumping off a wall 4 meters high	Pain over hernia	No sac present. Sutured transversus abdominis and internal oblique in separate layers followed by approximation of external oblique and latissimus dorsi muscles
Pavcovich.... 1942	M	68	R and L	Small	Associated with lipoma	Pain in loin	Chromic catgut no. 2 in latissimus dorsi and external oblique muscles
Kapsinow 1943	M	48	L	Admits two fingers	Lifting	Dull pain	Excised sac; Dowd's technic
Stubenbord 1944	M	23	L	.....	.....	Severe pain in loin	No sac; chromic catgut in latissimus dorsi and external oblique
Masson 1945.	F	42	R and L	5 inches in diameter	Congenital	Constipation; two attacks of severe pain	Sac was not opened; repaired with fascia lata sutures

* Probably a Petit hernia.

per cent. Von Baracz earlier had listed an additional factor of local suppuration and formation of abscess as a cause in 7.6 per cent of the cases on which he collected data.

Sillman reviewed seventy-eight cases of lumbar hernia in 1925 and found that in eight cases (10.3 per cent) the hernia was strangulated. Eighteen of the seventy-eight patients were treated surgically. Watson reported that in 11.3 per cent of his reviewed cases the hernia was strangulated.

TABLE II

CASES OF LUMBAR HERNIA ENCOUNTERED AT THE MAYO CLINIC

Case	Patient		Side	Cause	Size	Duration, Yrs.	Site
	Age, Yrs.	Sex					
1	71	M	R	Spontaneous	Small	..	Petit's
2	38	F	R	Observed after automobile accident and injury to left hip	Orange	13	Petit's
3	73	M	R	Spontaneous	Small	..	Petit's
4	75	M	R	Spontaneous	Orange	3	Petit's
5	42	M	R	Site old stab wound	Good size	3	Lumbar
6*	47	M	R	Site old stab wound	¾ inch hiatus in lumbar aponeurosis	..	Lumbar
7*	48	F	R	Injured right side of back while pregnant	3 inch at neck of sac	20	Lumbar

* Surgical treatment was carried out.

SYMPTOMS AND DIAGNOSIS

The symptoms of Petit's hernia are essentially those of hernia elsewhere; that is, presence of a mass located above the iliac crest, which may or may not be entirely reducible and which transmits a cough impulse. Dyspepsia and constipation are frequent symptoms. Many patients complain of a sense of local pressure or pain. Straining or heavy lifting may initiate the development of the hernia while in other cases the enlargement is gradual with an absence of etiologic factors. Often there is a history of trauma or local infection.

One must consider the presence of a lipoma, fibroma, fluctuant cold abscess, hernia of muscles or hematoma in the diagnosis of cases of lumbar hernial masses.

REVIEW OF PREVIOUSLY REPORTED CASES OF SURGICAL TREATMENT OF PETIT'S HERNIA

In fifteen previously reported cases Petit's hernia (Table 1) has been submitted to surgical repair. In 1888, Owen reported the first repair. He approximated the muscles with catgut. In 1894, Bull used kangaroo tendon. In 1907, Dowd formed a flap from the aponeurosis covering the gluteus maximus and medius muscles and turned it up over the defect. In 1917, Rishmiller made a flap from the aponeurosis of the latissimus dorsi and covered the defect with this flap. Kapsinow used Dowd's technic. In the remaining cases the defect was small enough to be obliterated by simple approximation of the latissimus dorsi to the external oblique muscle. The size of the defect ranged from very small to one larger than the palm of the hand. In five cases the sac was excised. It was inverted in one case and in five cases no sac was present. Great caution should be exercised in entering the sac because of the intimate relationship of the large bowel and the kidneys and ureters to the sac. Turner penetrated the colon in such an attempt.

In only two of the thirteen previously reported cases in which the sex of the

patient was stated was the patient female and in but two of the twelve cases in which the cause of the hernia was stated was the result of senile degenerative changes in the tissues, perhaps associated with a previous weakness in this region.

Fig. 1. Specimen showing anterior sacral meningocele, uterus and left tubo-ovarian abscess.

hernia congenital. Bilateral hernias were present in one case. The hernia occurred on the left side in ten of the thirteen cases in which the side was stated. Pain or soreness over the hernia was a symptom in eight cases.

LUMBAR HERNIA ENCOUNTERED AT THE MAYO CLINIC

Only seven cases of true lumbar hernia have been encountered at the Mayo Clinic prior to the case reported in this paper. All of the hernias were reducible and only one patient complained of discomfort. In four cases the hernia was considered to be Petit's hernia while in the remaining three it was classified as lumbar hernia. Table II presents data on these seven cases. In five of the cases the hernia was asymptomatic and surgical treatment did not seem necessary. A history of trauma was present in four cases; in three cases the hernia occurred spontaneously. The spontaneous hernias occurred in patients more than seventy years of age and were probably

In one of the two cases in which surgical treatment was carried out a ¾ inch (2 cm.) hiatus in the lumbar fascia produced by an old stab wound was closed with chromic catgut after the sac had been excised.

In the second case a 3 inch (8 cm.) opening in the lumbar region was closed with two rows of chromic catgut and seven strips of fascia lata each 8 inches (20 cm.) long. The sac contained ascending colon and was inverted. This patient had been injured in an accident in 1918, following which a Petit hernia developed. Four attempts at repair had been made prior to her admission to the clinic. Three years after the repair of the hernia at the clinic a small recurrence was reported by correspondence.

ANTERIOR SACRAL MENINGOCELE

Anterior sacral meningocele is a type of spina bifida in which there is usually a defect in one-half of the sacrum, through which a meningeal hernia presents. Occasionally, elements of the spinal cord or

nerves may be present in the hernial sac, the lesion then being designated a meningomyelocele.

Coller and Jackson reviewed the literature in 1943 and found a total of twenty-three cases to have been reported. In 1938, Adson reported a case, not included in Coller's series, in which successful operation was performed by the posterior approach. Shidler and Richards reported three additional cases, in one of which they operated successfully by the posterior approach. Our case brings the reported cases to a total of twenty-eight. In twenty-one of the twenty-eight cases surgical treatment has been carried out with a mortality rate of 38 per cent, the majority of deaths resulting from meningitis. In eleven of the cases the result is reported to have been satisfactory but in two cases there was no improvement.

Anterior sacral meningocele occurs more frequently among female than among male patients in the ratio of 24:4 in the reported cases. Coller and Jackson found that the lesion usually manifests itself in the first three decades of life. The meningocele enters the pelvis through a congenital anterior sacral defect, more often on the right side than on the left. They stated that the diagnosis rests on the triad of a lifelong history of constipation, a retrorectal tumor mass and roentgenologic evidence of a sacral defect. However, one must also consider the possibility of a retroperitoneal dermoid, lipoma, chordoma or an ectopic kidney.

FIG. 2. Pelvic roentgenogram showing the right sacral defect.

FIG. 3. Anterior view of patient before repair of the right Petit hernia.

FIG. 4. Posterior view of patient before repair of the right Petit hernia.

FIG. 5. Posterior view of patient after repair of the right Petit hernia.

The first successful operation for anterior meningocele, performed in 1903 by Pupovac, was carried out by the posterior approach. Coller and Jackson stated that the abdominal approach had been used in four cases, in one of which the outcome was fatal.

An examination of the records of the clinic reveals that only three cases have been encountered in addition to Dr. Adson's case and our own. In 1915, Dr. C. H. Mayo performed an abdominal drainage type of operation on an anterior meningocele. The patient, a girl, was then twenty-two months of age; she lived long enough for a teratoma to develop in the pelvis at the age of twenty-three years. Dr. Judd removed a small anterior meningocele by a posterior Kraske incision from another patient, a woman thirty-eight years of age; she recovered after the operation. The third patient, a woman thirty-one years of age, died of chronic meningitis after four years' duration as a result of a spontaneous fistula between the anterior meningocele and the rectum. She had given a history of discharge of up to 1 pint (473 cc.) of spinal fluid daily from the rectum.

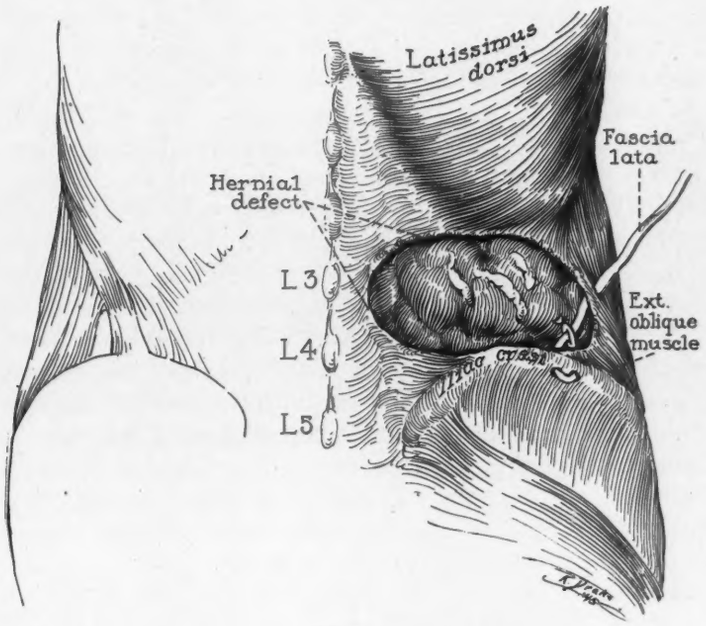

Fig. 6.

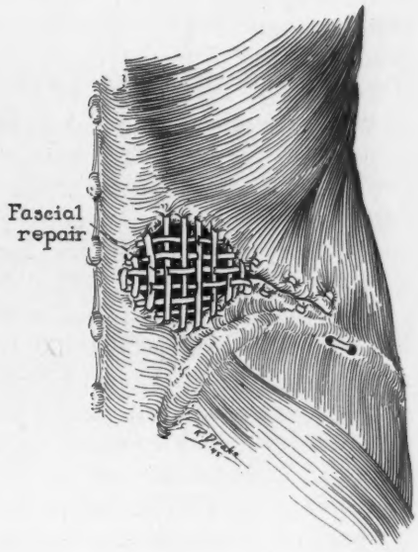

Fig. 7.

Figs. 6 and 7. Repair of hernia with fascia lata by anchorage to iliac crest and to the transverse processes of the third and fourth lumbar vertebrae.

CASE REPORT

The patient, an American born, white woman, forty-one years of age, was first examined at the clinic September 22, 1944. Her only previous illness had been an attack of influenza in 1918. Tonsillectomy had been performed at the age of fifteen years and ligation of the Fallopian tubes in 1926. Her mother had died at the age of fifty-four years of meningitis and her father had died of cancer of the stomach. One full sister and a half brother were living and well. She stated that bilateral Petit's hernia had been present since birth but had never caused her discomfort, even during her normal pregnancy and delivery twenty years earlier. However, about ten years before, the hernia on the right side had begun to enlarge and during the past two years it had enlarged rapidly. The first attack of abdominal pain had occurred one year prior to admission and had persisted for one hour. A second attack had occurred about one month prior to admission with an acute, severe pain in the left flank associated with abdominal distention but no vomiting. Her physician had manipulated the hernial mass and had been able to reduce it, after which the symptoms had subsided.

The patient exhibited no neurologic findings; she had good control over urethral and anal sphincters. She was 60½ inches (154 cm.) tall

and weighed 172 pounds (78.0 kg.). Her blood pressure was 108 mm. of mercury systolic and 76 diastolic, the pulse 104 and temperature 98.6°F. She was edentulous. A large pelvic mass measuring 12 by 12 cm., non-tender and movable, displaced the cervix anteriorly. This was thought to be ovarian in origin. The patient gave a history of menorrhagia the first two to three days of her period, which lasted about six days. There was mild leukorrhea. There was a huge apron-like Petit's hernia in the right lumbar region and a small hernia in Petit's triangle on the left side. One could palpate bowel and the right kidney in the contents of the hernial sac.

On September 28, 1944, while the patient was under nitrous oxide and ether anesthesia, the pelvic mass was explored through a secondary low midline incision with excision of the umbilicus. The cyst was ruptured in the course of removal and proved to be a meningocele, which was connected to the spinal canal through an opening 2.5 cm. in diameter in the sacrum. Since it was not possible to ligate the neck of the meningocele sac or approximate the edges of the defect, two pieces of oxidized gauze impregnated with thrombin were inserted into the spinal canal and two additional pieces were placed over the aperture of the opening. The retroperitoneal tissues were approximated as well as possible. A tubo-ovarian abscess was present on the left side and cystic oophoritis affected the right ovary. The pelvis was one mass of adhesions and the uterus was firmly fixed to the anterior abdominal wall. Total abdominal hysterectomy and bilateral salpingo-oophorectomy were performed with much difficulty. (Fig. 1.)

The pathologist reported the cyst to be a meningocele measuring 12 by 11 by 9 cm. Subinvolution of the uterus was graded 2 (on the basis of 1 to 4, in which 1 designates the mildest and 4 the most severe condition). The uterus contained a single fibromyoma 6 mm. in diameter. The endometrium was hypertrophic. Chronic cystic cervicitis and bilateral subacute and chronic salpingitis with perisalpingitis were present. A tubo-ovarian abscess, 6 cm. in diameter, involved the left tube and ovary. In the right ovary there was chronic cystic oophoritis.

Postoperatively, residual urine was present in the bladder for a few days; otherwise the patient's convalescence was uneventful. She was dismissed to her home on the thirty-third postoperative day, at which time the incision was well healed and the pelvic examination gave negative results. A postoperative pelvic roentgenogram (Fig. 2) revealed asymmetry of the pelvis with a right sacral defect and with sacralization of the fifth lumbar vertebra.

The patient returned to the clinic on May 8, 1945, for repair of the right Petit hernia. (Figs. 3, 4 and 5.) She now noticed sharp shooting abdominal pain when she climbed stairs and she had increased difficulty from constipation. No recurrence of the pelvic meningocele was detected by pelvic examination. Urinanalysis showed a specific gravity of 1.015, acid reaction, albuminuria, grade 1, and 3 leukocytes per high power field. The concentration of hemoglobin was 10.5 Gm. per 100 cc. of blood. Erythrocytes numbered 5,450,000 and leukocytes 8,800 in each c.mm. of blood. The Kahn reaction was negative. A roentgenogram of the thorax showed slight dorsal scoliosis.

On May 12, 1945, after the gastrointestinal tract had been thoroughly emptied by means of cathartics and enemas and while the patient was under continuous spinal anesthesia, a large amount of skin and subcutaneous tissue overlying the hernial sac was excised. The sac was found to contain the greater part of the intestinal tract and the right kidney. There was an oval-shaped defect about 5 inches (13 cm.) in width in the region of Petit's triangle, which was the result of a congenital absence of the attachment of the transversus abdominis and internal oblique muscles to the transverse processes of the lumbar vertebrae and to the crest of the ilium. The sac was inverted without opening the peritoneal cavity and the defect was closed by a basket-weave type of repair, using seven strips of fascia lata, each about 8½ inches (22 cm.) in length, taken from the right thigh by the Masson fascia stripper. The fascia (Figs. 6 and 7) was anchored through drill holes into the crest of the ilium and by taking the fascia through the ligaments about the transverse processes of the third and fourth lumbar vertebrae. Five Gm. of sulfathiazole was placed in the incision and a split rubber tube drain was inserted down to the aponeurosis.

The patient made an uneventful convalescence and the incision healed by first intention. She was dismissed on the twenty-sixth postoperative day to return to her home. When she was examined at the clinic four and a half

months after the second operation, she was found by both rectal and vaginal examinations to be without evidence of recurrence of the pelvic meningocele and to have a very firm repair of the right Petit hernia. She will return to the clinic at a later date for repair of the left Petit hernia.

SUMMARY

We have reported data on a case in which there were two unusual lesions of congenital origin, bilateral Petit's hernia and anterior sacral meningocele, both of which proved amenable to surgical treatment. Although anterior sacral meningoceles are rare, they must be considered when dealing with retroperitoneal pelvic masses. These lesions are of particular importance to the surgeon, since he is faced with the possibility of fatal meningitis unless he recognizes the lesion and repairs it at the time of operation. Closure of the defect in the continuity of the spinal canal in this case was accomplished by use of oxidized gauze packs impregnated with thrombin. A large, incapacitating Petit hernia was repaired by a basket-weave method, using strips of fascia lata with anchorage to the iliac crest and transverse processes of the lumbar vertebrae.

Although a Petit hernia is unusual, the case reported is even more so, since the hernias were congenital and bilateral.

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TRAUMA TO THE ABDOMEN

HENRY H. RITTER, M.D.
Clinical Professor of Traumatic Surgery,
Columbia University

AND

B. BERNARD KAYE, M.D.
Associate in Traumatic Surgery,
Columbia University

NEW YORK, NEW YORK

THE war and the increased speed in production and transportation have added to the number of injuries to the abdomen and its contents. These injuries call for an early and accurate diagnosis, and the institution of immediate treatment.

Abdominal injuries are classified as penetrating and non-penetrating.

PENETRATING TRAUMA

Penetration of the abdominal wall may be caused by bullets, bomb or shell fragments, knives or bayonets, flying splinters of wood, glass or other objects.

Penetrating injuries relieve the surgeon of the responsibility of deciding whether or not operation is indicated since all penetrating wounds must be explored, even though some do not enter the peritoneal cavity. The decision as to whether or not operation is indicated in cases seen after twenty-four hours will depend upon the physical findings.

Although the use of penicillin and the sulfa drugs have lessened the number of deaths in abdominal injuries, the mortality rate still remains high. Hamilton and Duncan[44] report an operative mortality of 48.9 per cent in 190 cases of gunshot wounds of the abdomen. Elkin and Ward[26] report an operative mortality of 46.4 per cent in 209 rifle and pistol wounds of the abdomen, and 55.2 per cent in twenty-nine cases of shotgun wounds of the abdomen. DiLorenzo[22] reports a mortality of 78 per cent in nine cases of gunshot wounds of the small bowel and 71 per cent in seven cases of gunshot wounds of the large bowel. Mulholland[66] reports a mortality of 51 per cent in seventy cases of penetrating abdominal wounds.

Gordon Taylor[40] points out that wounds penetrating the abdomen from one side to the other are more serious than those proceeding anteroposteriorly. In perforating wounds the line of the tract acts as a clue to the path of the missile and the structures likely to be involved. The straight line path does not hold when there is no wound of exit.[69] *X*-ray localization is helpful. Absence of an exit wound does not necessarily mean that the foreign body is lodged within the peritoneal cavity. It may be buried in the abdominal parietes, rectum, bladder, vertebral column or retroperitoneal space.

The greatest single cause of death in gunshot wounds is shock and hemorrhage with peritonitis less than half as frequent. There is a progressive increase in mortality from peritonitis as the level of the bowel perforation descends from the jejunum to the colon.

The entrance wound produced by a bullet is almost invariably smaller than the caliber of the bullet, while wounds of exit are larger. The wound of entry caused by a rifle bullet usually has a small more or less circular appearance.[98] Injuries caused by fragments are more disruptive and cause considerable laceration of the underlying muscle and irregular tears of the viscera. Fragments are usually irregular and may carry pieces of clothing into the abdomen.

It is important to ascertain the time interval between the injury and operation, as well as the direction of the force. The possibility of associated injuries to the back, loin and thorax must be carefully considered.

Stab wounds that penetrate the peritoneal cavity may not injure the viscera,

and Martin[56] failed to find visceral injury in thirty-one of the fifty-seven cases of stab wounds in his series. Exploratory laparotomy may reveal perforating wounds without visceral involvement.[10] It is impossible to make this diagnosis without visceral inspection.

Rippy[83] claims the mortality of stab wounds is not as high in civilian cases as the knife blade is not as long as the bayonet and therefore causes less intraperitoneal damage. The intraperitoneal damage will depend upon the length of the blade, the amount of force and the thickness of the abdominal wall. Bayonet wounds differ but little from stab wounds seen in civilian life. Exploration is indicated when there exists any question of doubt as to the depth of the wound and one must not wait for clinical signs to establish the diagnosis. Greater attention is given to the suturing of the injured viscera and less to the débridement of the superficial wound.

The peritoneum has remarkable powers of combating infection. This power is enhanced by the removal of sources of infection and by the closure of all perforations in the hollow viscera. It is useless to attempt sterilization of the abdominal cavity by irrigation or similar means.

Willis[103] states that multiple small visceral wounds produced by buckshot at close range defy surgical repair, as a rule, and that patients who have such wounds may recover under conservative treatment.

Lovelace[54] warns against transportation of suspected intestinal injuries at comparatively high altitudes, as the gas in the intestine expands and may be forced through small perforations or the traumatized intestinal wall.

NON-PENETRATING TRAUMA

Intra-abdominal injuries may be present in spite of an intact overlying skin.[5] Non-penetrating injuries may be sustained under confusing conditions and the history may be vague and indefinite.[87] The site of internal injury may be suspected by bruising of the overlying abdominal wall.

The causative factors of violence may be generalized, such as run-over accidents, falls from a height, compressions, blast injuries and tears of a viscus by fractured bone spicules; or localized, such as a punch, a kick or thrust by a dull implement.

Local or circumscribed blows commonly injure the intestines, mesentery and bladder, while diffuse blows usually injure the solid and fixed organs. Fatheree[29] in his review, states that 60 to 78 per cent of intra-abdominal injuries by blunt force affect the solid organs. This is due to the firmer fixation of these structures as compared to the mobility of the hollow viscera. A relaxed and flabby abdominal wall requires less force to cause injury to the intraperitoneal organs than a muscular and firm abdominal wall. The effect of a blow upon the viscera will depend upon whether or not the hollow viscus is distended or empty. A distended hollow viscus and an enlarged pathological solid viscus are more prone to injury.

A sudden increase in the intra-abdominal pressure by a crushing injury may compress the fluid or gas in a single loop of intestine[43] and wedge the viscus between the instrument of force and the spinal column. The introduction of gas or solid objects into the rectum may cause intra-abdominal damage. Penetration of a viscus by spicules of bone is not frequent and is seen in fractures, particularly of the pelvis. Blast injuries may cause severe intra-abdominal damage without any evidence in the abdominal wall.

Immersion blast may result in immediate death or present the picture of an acute condition of the abdomen. Severe visceral damage or retroperitoneal hemorrhage may be produced by blast without any external evidence of injury.[41] The general picture may be misleading and the decision as to operative intervention difficult. Late perforation may occur as a result of gross bruising and damage to the blood supply. Pinnock and Wood[74] stress the extreme

difficulty which may arise in differentiating between upper abdominal rigidity due to peritonitis and that secondary to a thoracic lesion. The microscopic examination[25] reveals fragmentation and perforation of all the intestinal layers. The apposing edges are infiltrated with leucocytes, lymphocytes and plasma cells, and show considerable superficial necrosis. Comparatively little regenerative cell growth, fibroblastic activity or evidence of repair are noted around the perforation.

Stein,[92] Webster, Ross and Alford[102] state that the prevention of this entity can be enforced by instructing individuals who anticipate under-water detonations, to float on their backs or elevate the buttocks above the water level.

SHOCK AND HEMORRHAGE

The differentiation between hemorrhage and traumatic shock is sometimes difficult. The clinical picture may add little, yet the laboratory findings are of great value. Shock and hemorrhage are the most common immediate causes of death. Hemorrhage must be controlled and shock prevented or overcome. Hemorrhage is tolerated poorly by the very young, the aged and the diseased. Women withstand hemorrhage better than men.

The symptoms and signs of hemorrhage are restlessness, thirst, air hunger, palor, cold, moist skin, widely dilated pupils, subnormal temperature, nausea, syncope, vertigo, disturbance in vision and a rapid thready pulse. There is a fall in blood pressure. As a rule the blood count shows a loss of red cells and an increase in white cells. In abdominal injuries hemorrhage may be delayed and a secondary hemorrhage is not altogether uncommon. A secondary hemorrhage may occur two or three weeks after the original injury.

In traumatic shock there is a drop in blood pressure, a rapid thready pulse, a diminution in the blood volume, an increase in the red blood cells and percentage hemoglobin, the temperature is subnormal, the skin is cold and moist, there is a grayish and slightly cyanotic appearance and the respirations are superficial and often of the sighing type. Hematocrit readings, the determination of the specific gravity of the blood and the serum protein will indicate the amount of blood or blood plasma loss and the necessary treatment. An early leucocyte count is of little value. Wangenstein[99] found that the white blood cell count is usually normal in cases of perforation of a hollow viscus and slightly elevated in cases of hemorrhage. Scudder[88] claims a constant rise in the plasma potassium content in shock, whether it is due to trauma, toxine, hemorrhage or loss of fluids.

Shock and hemorrhage therapy precedes any surgical intervention unless there is active bleeding. A continuous fast pulse with a falling blood pressure, despite shock treatment, suggests bleeding and demands operative intervention. Hemorrhage must be controlled by ligating any bleeding points and the shock of hemorrhage by the intravenous administration of blood. Shock is treated by covering the exposed viscera with warm saline pads to protect the belly wall. The patient should be kept warm. Morphine is indicated in all cases excepting those of suspected head injury. The use of renal cortical extract has proven of value and the administration of 5 to 10 cc. of eschatin may have a very decided beneficial effect. Shock position, that is, the foot of the bed elevated, although frowned upon by some, has been found of value by us. The inhalation of oxygen by masque, nasal tube or tent has been proven efficacious. Plasma intravenously has been most effective. The intravenous administration of 5 per cent glucose in a normal salt solution may be carried out until plasma is obtained.

CLINICAL PICTURE

Abdominal trauma may be classified into three groups:[35] (1) Severe multiple injuries which are usually rapidly fatal regardless of treatment; (2) cases that require immediate operation; and (3) cases in which

the diagnosis is doubtful and the type of treatment is undecided.[55]

The decision as to operation will depend upon the general appearance of the patient, the pulse, blood pressure, abdominal signs and the laboratory findings. As a rule there is a history of trauma[46] followed by abdominal pain. Localized early pain, spreading and becoming generalized, suggests leakage. A ruptured hollow viscus causes immediate peritoneal irritation, with a resultant pale, drawn face and an alert and apprehensive expression. In addition, there is pain aggravated by motion, vomiting, rapid costal breathing, abdominal tenderness, rigidity and tympanites. These findings are finally supplemented by listlessness and signs of toxemia. Severe persistent pain, continuous or intermittent, localized or generalized, associated with vomiting or retching and diffuse tenderness and muscle spasm, with or without signs of hemorrhage, demands immediate exploratory laparotomy.

Examination. A general physical examination will detect wounds entering the abdomen via the buttocks, thighs, perineum or thorax.

Inspection. Inspection will reveal gunshot and stab wounds as well as contused areas resulting from blunt non-penetrating trauma. A stab wound may extend down to the peritoneum but not into it. Herniation of omentum is indicative of peritoneal penetration. The exposed viscera may vary from a protrusion of one or two segments of intestine to a complete evisceration. A fullness may be visible in the abdominal wall, in the abdominal cavity or in the retroperitoneal tissues. An intraperitoneal tumefaction goes through a wider range of respiratory excursion than a retroperitoneal enlargement. The absence of abdominal wall excursion indicates peritoneal irritation and perforation. Hemorrhage from a solid organ may result in a localized swelling, whereas hemorrhage or leakage from a hollow viscus or mesentery will result in a diffuse swelling.

Palpation. Rigidity of the abdominal muscles is a measure of the degree to which the parietal peritoneum has been irritated.[61] Thoracic, vertebral and abdominal wall injuries may result in abdominal pain, rigidity and distention. The rigidity of the purely thoracic wound is strictly unilateral, whereas the rigidity in abdominal wounds is bilateral.[9,70]

Percussion. An area of unusual dullness following an abdominal injury suggests a collection of blood or intestinal contents in the peritoneal cavity. It requires about 6 quarts of fluid to illicit shifting dullness, therefore, the demonstration of free blood in the peritoneal cavity is of doubtful diagnostic value.

Roentgen Studies. Roentgenograms are of diagnostic aid in revealing gas within the peritoneal cavity following rupture of a hollow viscus[80] and determining the location of foreign bodies.[37] Gas when present in the peritoneal cavity is certain evidence of hollow visceral perforation. Unfortunately, the absence of pneumoperitoneum does not entirely exclude rupture of a hollow viscus.[27,28,31] Free air under the diaphragm is more commonly present in perforations of the upper small bowel. Perforations especially at the ileocecal valve may be temporarily sealed off and thereby prevent the escape of gas. The condition of the patient will determine whether roentgenograms are taken in the erect or in the lateral decubitus position.[8,15]

Preoperative Care. It is inadvisable to rub the abdomen, as vigorous rubbing may stimulate peristalsis or actually compress the gas filled intestines and increase the escape of intestinal contents. Sedation, antitetanic and antigas sera, should always be administered.

Anesthesia. Anesthesia in abdominal trauma is a controversial subject. The ideal anesthesia will combine high oxygenation, complete abdominal relaxation, maintenance of the blood pressure and early return to consciousness following the discontinuation of the anesthetic.

Peterson, of our Department, believes that cyclopropane alone or in conjunction with small amounts of ether comes closest propane has been found to be an extremely valuable drug in obtaining complete relaxation comparable to that of spinal anes-

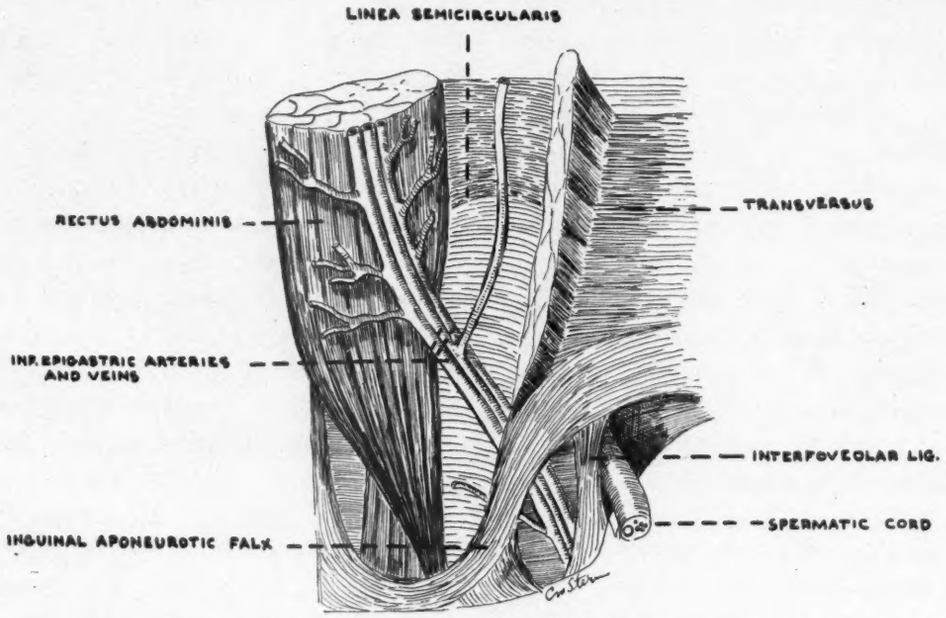

FIG. 1. Anatomy of rectus muscle and epigastric vessels.

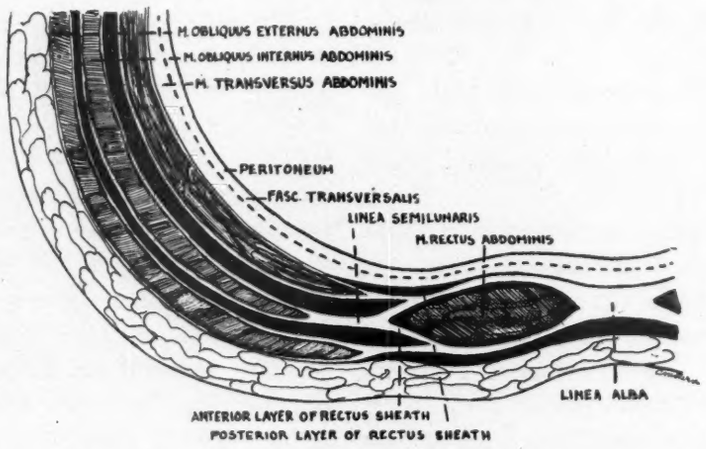

FIG. 2. Cross section of abdominal wall.

to fulfilling these requisites, Induction is rapid with absence of minimal excitement. High oxygenation is maintained because of the high potency of the agent. The recovery period in which premedication is not excessively heavy is rapid, within a period of five to ten minutes. Circulation is not depressed but most frequently improved. Relaxation may or may not be readily obtained with cyclopropane, depending upon the physical status of the patient and the skill of the anesthetist. Curare combined with cyclothesia. Endotracheal intubation is indicated when there is difficulty in maintaining an airway and there is danger of aspirating gastric or intestinal contents.

Strode[95] and many others[53,82] prefer ether as the easiest and safest anesthesia. Sodium penthothal is preferred by Rose and Hulkert.[12] Spinal anesthesia is preferred by Storck[94] and Bove,[12] when there are no signs of impending shock.[6,66] Local anesthesia is rarely used[84] but may be utilized for superficial wounds not penetrating the peritoneum.

PROCEDURE

Incision. The incision should be ample, through all the layers in the same plane and

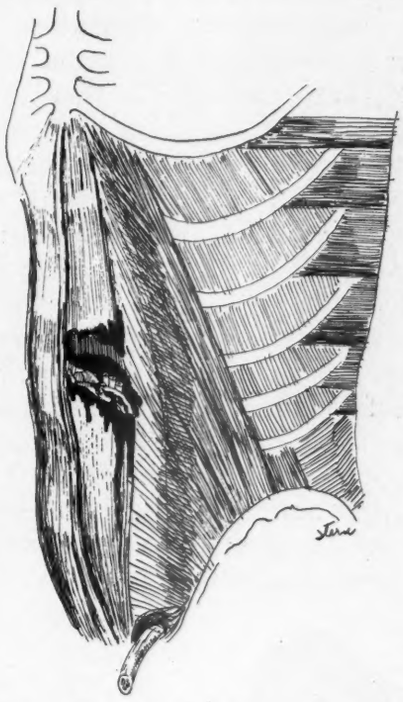

Fig. 3. Rupture of rectus muscle and epigastric vessels.

allow adequate access to the peritoneal cavity.[93] The incisions may be varied to meet the individual case. The commonly acceptedones are the vertical paramedian,[38] or median incision for approach to the central part of the abdomen or the pelvis, and the transverse or oblique lateral incision for access to the lateral parts.[33] The accidental wounds of entrance and exit

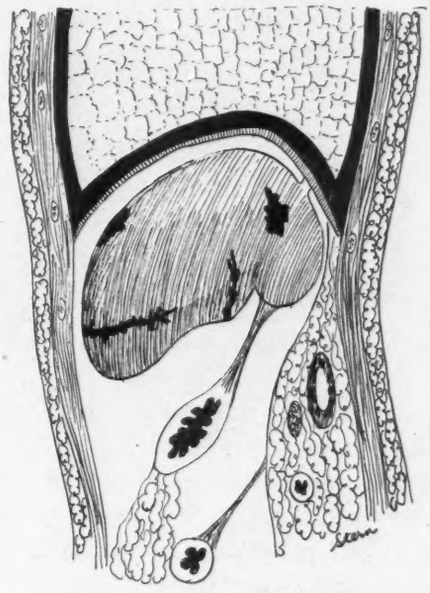

Fig. 4. Lacerations of liver.

are thoroughly cleansed and then excised.[97] In large wounds of the abdomen it may be advisable to incise through the penetrating wounds. In the smaller gunshot or stab penetrations it may be more advantageous to avoid the original wound and utilize a separate incision.

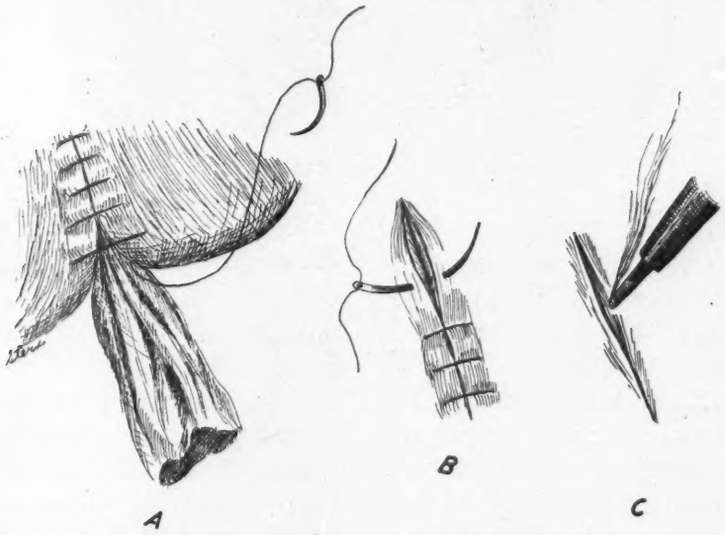

Fig. 5. A, packing of liver; B, capsular suture; C, cautery.

Operation. Upon opening the peritoneum one notes the presence of intestinal contents, blood or gas. Hemorrhage is

controlled by finding the bleeding vessels, clamping and ligating them. Avoid mass ligation. Massive hemorrhage may be controlled by digital pressure or pressure packing.

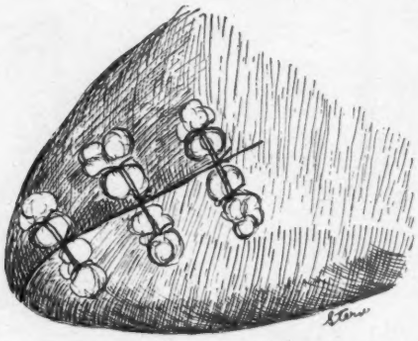

Fig. 6. Omental graft reinforcing suture line.

Foreign bodies, particles of clothing and detached particles of visceral content are quickly and gently removed. The use of moist sponges is advisable.

Irrigation with saline under pressure[55] has been discarded since the advent of sulfa and penicillin therapy,[26,66] but if it is necessary to cleanse the abdomen it is used. A systemic exploration is then carried out, starting at a fixed point. The viscera are examined for perforation and tears. Bleeding points are sought and the root of the mesentery inspected. Evisceration of more than one loop of bowel at a time during inspection is to be avoided if possible, because of the chilling effect and the drag on the mesentery.

In non-penetrating injuries by blows or compression, the exposure of a single region of the abdomen may be sufficient, whereas in gunshot wounds exploration of the entire abdominal cavity is indicated.

The large intestine is explored in sequence, beginning at the cecum and terminating at the rectum. The small intestine is then inspected, working upwards from the ileocecal valve to the duodenojejunal junction. Warm moist packs are used to handle the intestines and a Babcock marker will avoid unnecessary handling of the intestines.

Small longitudinal perforations are closed transversely by means of a continuous suture of fine chromic catgut which includes all the layers and a Lembert suture of interrupted fine silk sutures.

Multiple perforations in close proximity often require resection of the intestine and end-to-end anastomosis.

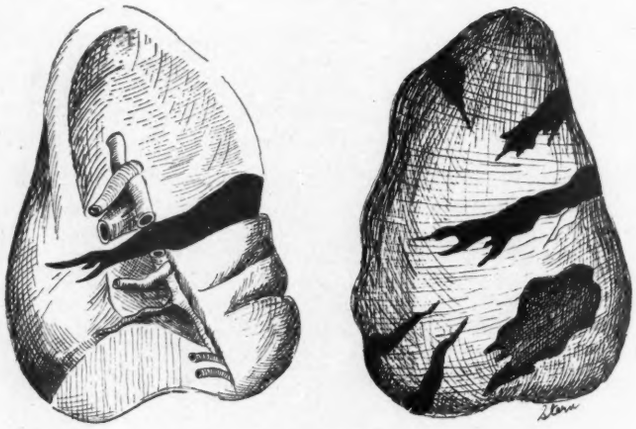

Fig. 7. Splenic tears.

Wound Closure. Upon completion of the exploration and repair of the damaged tissues and peritoneal cavity is again aspirated,[26] cleansed and dried. Four to 6 Gm. of sulfanilamide crystals are dusted into the peritoneal cavity.[34,47,57,64,65,104] The peritoneum is closed with either a running double strand of chromic catgut[3] or interrupted quilting cotton sutures.[11,106] The traumatized surface of the peritoneum is everted, thereby avoiding adhesions. Drainage[77] is always a matter for the judgment of the operating surgeon. The consensus of opinion is against drainage of the peritoneal

cavity,[63] yet a few favor drainage, as a slipped suture will permit leakage to the surface instead of bursting into the peritoneal cavity.[96] The absolute indications for drainage are the presence of bile in the abdomen and in the pancreatic wounds.

The incidence of wound dehiscence is particularly high after laparotomy for wounds of the liver, stomach and upper bowel. It is therefore suggested that through-and-through sutures of No. 28 stainless steel wire are inserted about

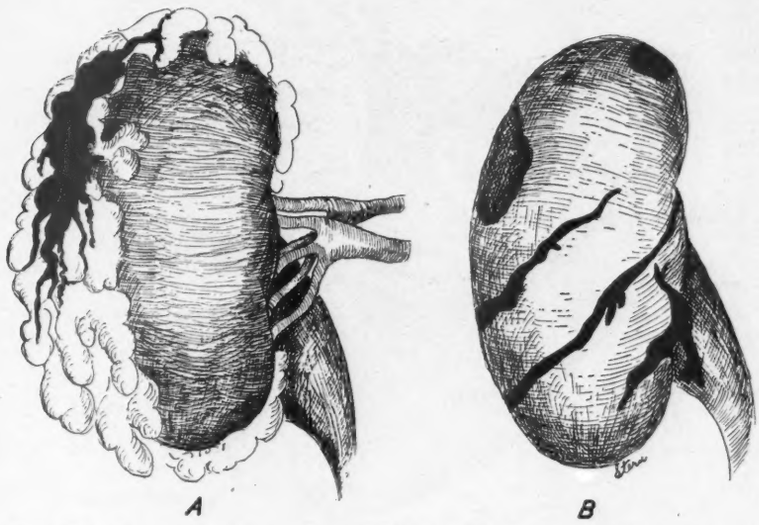

Fig. 8. A, hemorrhage in perirenal fat; B, kidney lacerations and contusions.

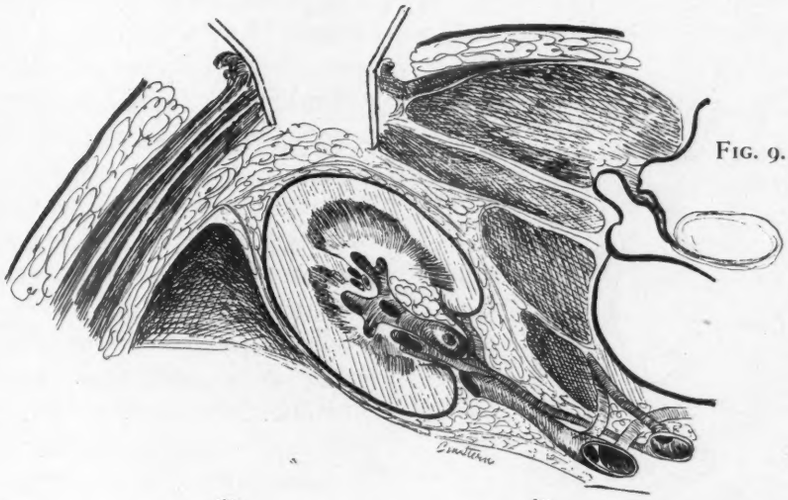

Fig. 9.

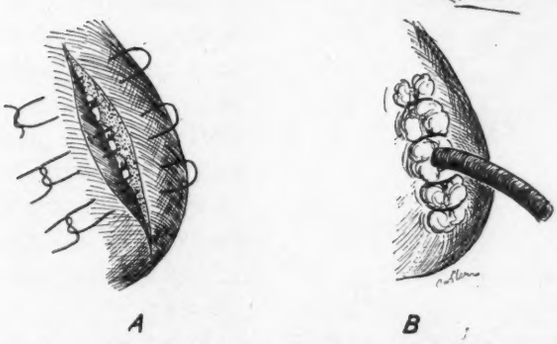

Fig. 10.

Fig. 9. Retroperitoneal approach to kidney.
Fig. 10. A, mattress suture; B, fat graft and drain.

½ inch apart.[37,48,68,75] The muscles are approximated with interrupted chromic catgut sutures loosely tied and the skin is closed with interrupted silk sutures loosely tied. The through-and-through sutures are then tied.

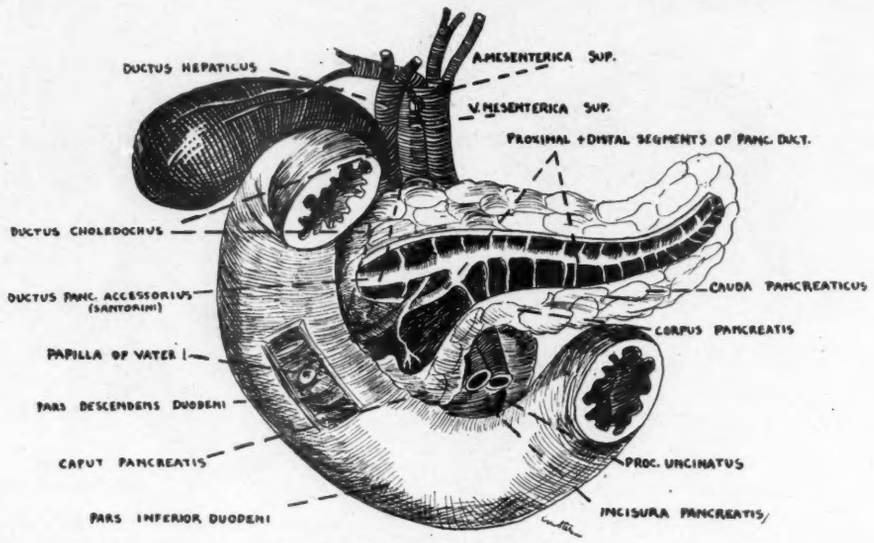

FIG. 11. Anatomy of pancreas.

ABDOMINAL WALL

Injuries to the abdominal parietes may vary from mild contusions with subcutaneous hemorrhage to a complete tear of the rectus muscle and the underlying epigastric vessels. (Fig. 1.)

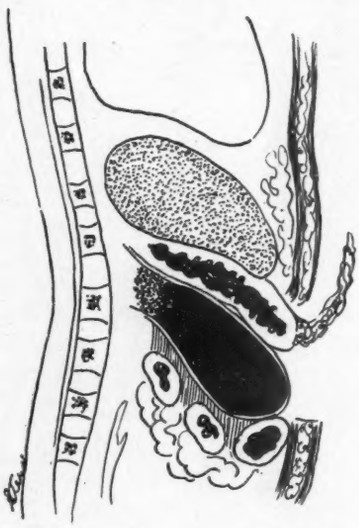

FIG. 12. Post-traumatic pancreatic cyst.

The entire muscular mass of the rectus[19] in the adult is 35 cm. long, 7 cm. wide and 8 cm. thick. (Fig. 2.) There is, of course, a wide range of variations according to body length, muscular strength and age.

Injuries may be caused by: (1) Direct trauma:[36] penetrating or non-prenetrating —as direct blows or stab and gunshot wounds, (2) indirect trauma: following violent effort, usually in young healthy adults.

It is frequently difficult to differentiate between hematoma of the abdominal wall, intraperitoneal bleeding and retroperitoneal hematoma.[72]

Contusion of the abdominal wall may result in sympathetic nerve stimulation with resultant pallor, anxious expression, nausea, vomiting and signs of shock. Peristalsis may be momentarily diminished. A simple contusion of the abdominal wall may be more painful than a visceral lesion before peritonitis sets in. When the parietal wall has been injured, localized tenderness and spasm will remain constant. Increase of intra-abdominal pressure will produce a protrusion of the abdominal mass when a hematoma of the abdominal wall is present.[72]

Deep rigidity must not be confused with painful spasm, limited to the abdominal wall as a result of trauma.[16] Progressive board-like rigidity indicates an intra-abdominal pathological condition.

Cullen[18] points out that when blood lies between the rectus muscle and the peritoneum the symptoms are usually those of an acute intra-abdominal lesion. Hemorrhage is due to the tearing of the muscle and the deep epigastric vessels. (Fig. 3.) The hemorrhage usually occurs below the umbilicus and is nearly always limited to one side. The free blood lies directly against the peritoneum producing an irritation causing severe pain and suggesting an intra-abdominal lesion. In those cases in which the rectus muscle ruptures anteriorly, blood escapes into the fat with resultant ecchymosis of the skin. Treatment consists of incision of the rectus sheath, evacuating the hematoma and ligating the bleeding vessels. A few loosely tied interrupted muscle sutures may be used for coaptation purposes. Extensive tangential wounds may require débridement and closure with steel wire or heavy silk.

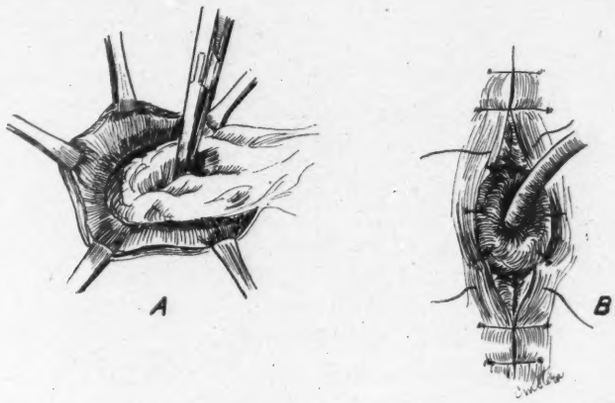

Fig. 13. A, opening and emptying of cyst; B, marsupialization of cyst.

LIVER

The large size, fixation, friability and slight elasticity of the liver predisposes it to extensive fissuring or rupture with fragmentation. (Fig. 4.) Irregular tears may extend from the free margin into the liver substance. Coexisting injuries to the gallbladder, cystic and common ducts may exist.

Clinical Features. These will depend upon the extent of the parenchymal and vascular damage. The picture may vary from a slight distress in the right hypochondrium to profound shock. Peritoneal irritation due to bile and blood may refer the pain to the right shoulder and right scapular region. Coexisting thoracic injuries must be excluded. *X*-ray studies may reveal elevation and immobilization of the right half of the diaphragm.

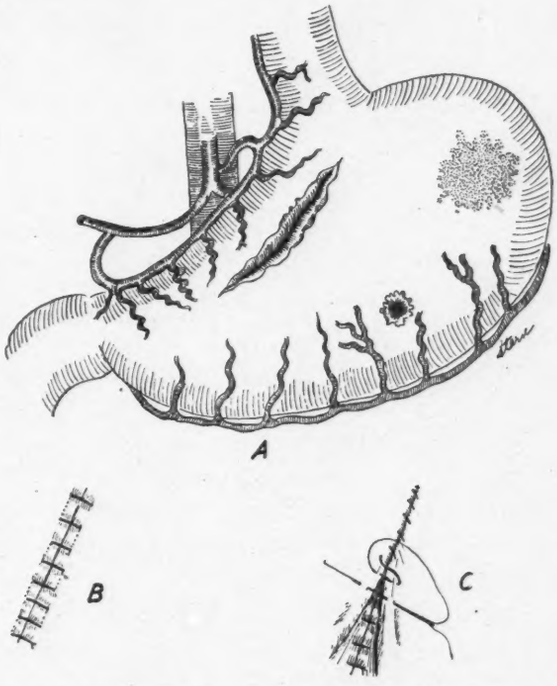

Fig. 14. A, lacerations of stomach; B, first row of sutures; C, second row of sutures.

Non-penetrating Trauma. Crushing or falling injuries may result in (1) rupture of the capsule and liver parenchyma, (2) subcapsular rupture, and (3) central rupture.

Penetrating Trauma. This may produce any degree of the above plus clean cut, ragged, or fragmented wounds that range from a simple penetrating wound to the separation and shattering of an entire lobe.

FIG. 15.

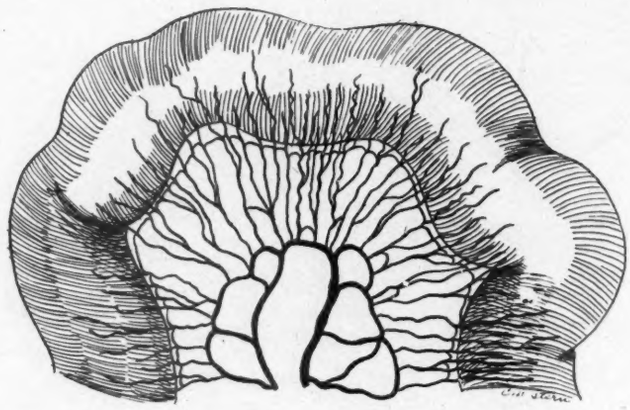

FIG. 16.

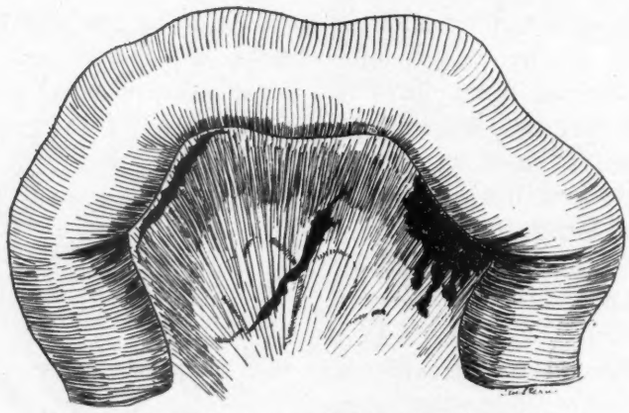

FIG. 15. Mesenteric branches to small intestine.
FIG. 16. Mesenteric tears.

Treatment. Treatment should be (1) conservative, when it is certain that other organs have not been involved, and provided there are no signs of increasing hemorrhage; (2) exploratory, when there are signs of increasing hemorrhage, extensive damage, retention of a large missile and for coexisting injuries to the hollow viscera. During the exploration for suspected liver injuries, the posterior and inferior surfaces of the liver require careful inspection. Detached or devitalized liver fragments must be excised.

Moderate bleeding may be controlled by the use of cautery (Fig. 5) or the application of topical thrombin and pressure. Liver bleeding may be temporarily controlled by digital compression of the hepatic artery and portal vein at the foramen of Winslow. More extensive bleeding may require packing (Fig. 5) or sutures which are loosely tied.

In extensive injuries of the liver it is advisable to cover the suture line with omentum or muscle and thereby prevent the suture material from cutting into the liver substance. (Fig. 6.) The packing is removed from the fifth to the eighth day, as too early removal may start bleeding. Whole blood transfusion is administered at the time of operation.

Gallbladder. Small tears near the fundus may require cholecystostomy. Large tears, or crushing injuries demand cholecystectomy.

Common Duct. A completely severed common duct is uncommon. It may be

repaired over a T tube or by ligation of both ends of the duct and anastomosis of the gallbladder to the duodenum or stomach.

Clinical Features. Hemorrhage is the main clinical feature associated with pain, tenderness, rigidity and absence of respiratory motion over the left upper quadrant. Tenderness may be present over the supraclavicular fossa between the insertion of the sternomastoid and of that of the scalenius anterior muscles. Pain in the left shoulder area or over the left scapula may be present. Roentgenographic studies may reveal an immobile or an elevated left diaphragm. There is an increase in the area of splenic dullness, and gastric tympany may be obliterated.

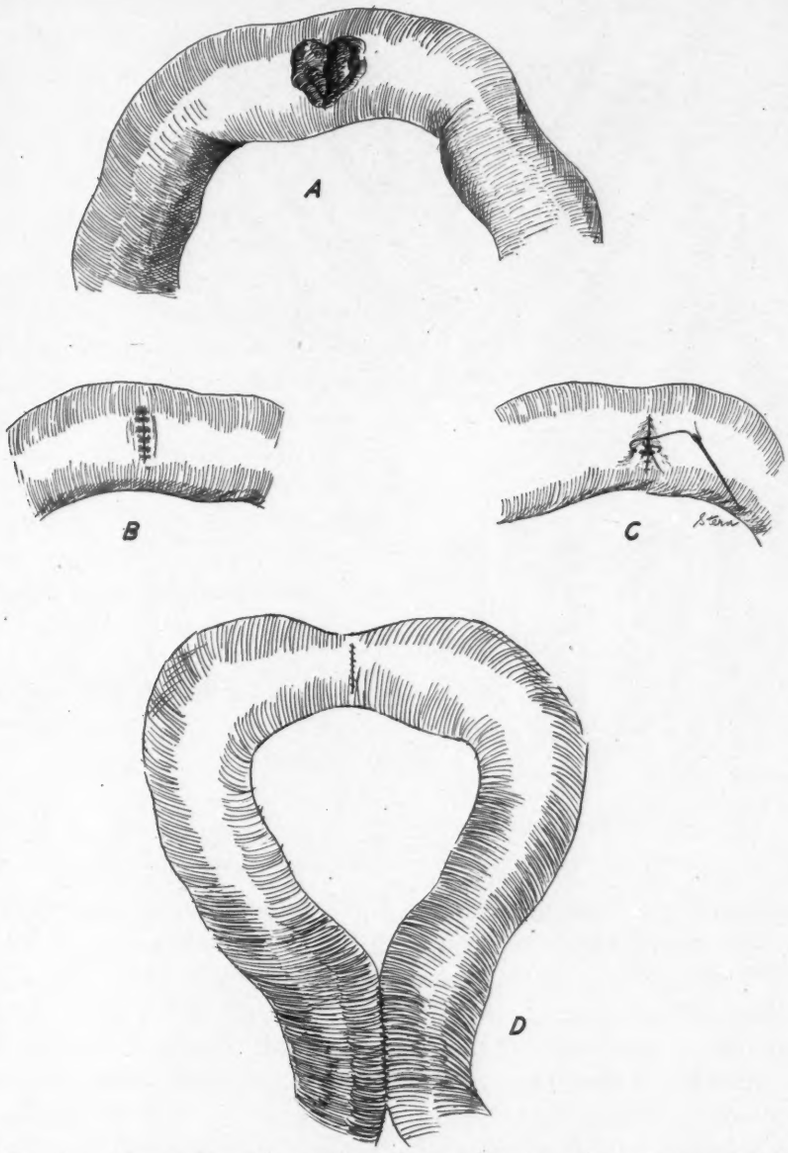

FIG. 17. A, lacerations of small intestine; B, first row of sutures; C, second row of sutures; D, lateral anastomosis.

SPLEEN

Splenic injuries are commonly caused by crushing trauma, falls, blows, fractured ribs and penetrating wounds. (Fig. 7.) The spleen is mobile, lacks elastic tissue and is fairly well protected by the thoracic cage. There may be coexisting injuries to the stomach, kidney, splenic flexure and jejunum. The lesions may vary from small single fissures to extensive lacerations with tearing of the linorenal ligament or pedicle.

There are two clinical syndromes: (1) Immediate hemorrhage with clinical manifestations of shock and hemorrhage, and (2) delayed hemorrhage with a latent period varying from forty-eight hours to several weeks.[21,30,91,109]

McIndoe[62] includes those cases in which the primary rupture is followed by complete or almost complete hemostasis for a latent period of more than forty-eight hours and then terminated by a delayed hemorrhage of dramatic onset and fulminating character. The pathological condition may manifest itself as capsular, subcapsular and parenchymal hematomas, or rupture of the hilar vessels.[85] Large hematomas may be the precursor of delayed hemorrhage. Waugh and Prior[101] emphasize the frequent association of rib fractures in delayed splenic hemorrhage.

Treatment. Suturing is not attempted as the spleen does not heal. McCarney[60] reviewed 25,000 autopsies and found no instance of healed splenic injuries. Wright and Prigot's[107] review of 3,000 autopsies showed no evidence of healed injuries.

The approach to the spleen is through a left paramedian incision which may require a horizontal extension. Blood clots are removed to allow visualization of the splenic pedicle. The splenic artery and vein are clamped under direct vision. Great care must be taken not to damage the pancreas or the stomach. The gastrosplenic and phrenicocolic ligaments are divided and the spleen is then removed.

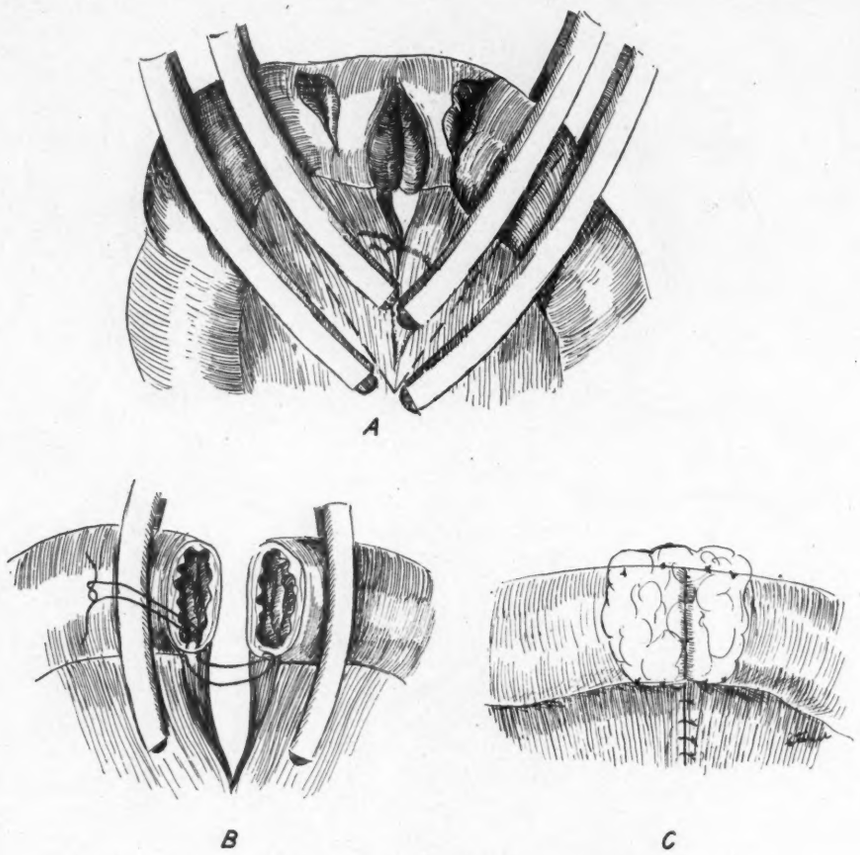

FIG. 18. A, resection; B, repair (end-to-end); C, omental graft.

KIDNEY

The kidney is a vascular organ covered by a firm capsule and perirenal fat. It is situated in the retroperitoneal space and protected by the overlying fascia, musculature and lower ribs. (Fig. 8.)

Injuries may be caused by: (1) Non-penetrating trauma; falls, blows and crushing injuries; (2) penetrating trauma; gunshot and stab wounds. Injuries may involve: (1) The hilum and large vessels. The renal

arteries are terminal and may result in necrosis of the kidney with resultant infection; (2) the pelvis, with leakage of urine into the retroperitoneal tissues or peritoneal cavity; (3) the parenchyma, with perforation, extensive laceration or bisection of the kidney; and (4) the perirenal tissues with hemorrhage and subsequent infection.

Clinical Features. The coexisting intra-abdominal trauma may mask the symptomatology. Hematuria is fairly constant, unless there is a severed ureter or urinary blockage by blood or renal tissue. Pain in the loin or costovertebral angle may be dull, lancinating or colicky in character. Renal shock may result in anuria. Renal or perirenal bleeding may produce a visual or palpable hematoma. There may be localized tenderness and rigidity in the lumbar region. Reflex peritoneal irritation may be manifested by adynamic ileus and abdominal rigidity.

X-ray studies may demonstrate a foreign body and evidence of renal injury, such as change in the size and contour of the kidney and absence of the psoas muscle outline. Intravenous urographic study may be helpful, but retrograde pyelographic study is dangerous,[99] unless one is prepared to operate immediately.[14] The capsule of the kidney is so firm that it will control hemorrhage unless the tear in the kidney is extreme. Immediate operation in kidney lesions is not usually indicated.

Treatment. Treatment may be (1) conservative in non-penetrating or penetrating injuries without signs of hemorrhage. Hourly red cell counts, hemoglobin, plasma volume, urine analysis, and blood pressure readings are charted. (2) *Operative:* Immediate operation is indicated for severe hemorrhage or marked peritoneal injury. The kidney is approached through a curved loin incision. (Fig. 9.)

When severe intra-abdominal injury is coexisting, laparotomy and exposure of the kidney through the posterior peritoneum may become necessary. The following procedures may be performed:

1. *Suturing of localized wounds:* The cortex is repaired by interrupted sutures, perirenal fat being utilized to reinforce the suture line. (Fig. 10.) Mattress sutures must be loosely tied as they may result in a wide area of necrosis. When the kidney pelvis has been opened, drainage is maintained for about forty-eight hours.

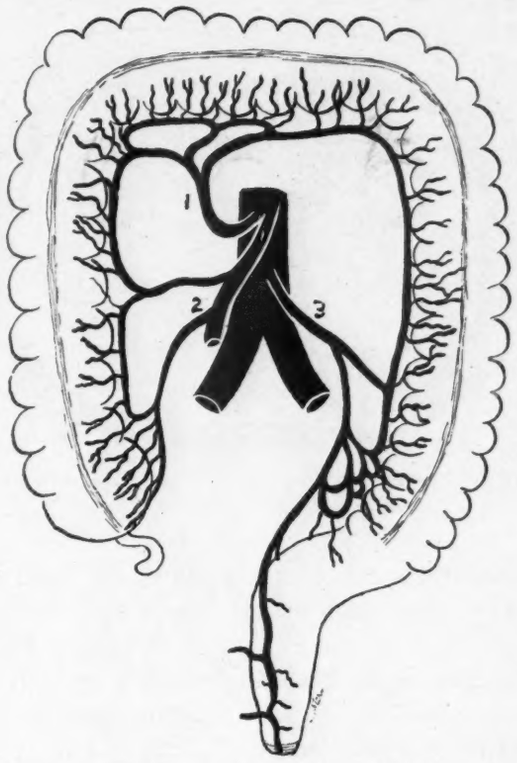

Fig. 19. Blood supply to large intestine: 1, middle colic artery; 2, right colic artery; 3, inferior mesenteric artery.

2. *Partial nephrectomy* is indicated when the trauma is limited to a branch of the renal artery, or for polar injuries involving a small section of the kidney. Nephrostomy drainage is maintained until a clear urine is obtained.

3. *Nephrectomy* is indicated for tears of the vessels of the pedicle, or for extensive fragmentation of the kidney. When the patient's condition is grave, clamps may be left on the renal pedicle for several days and no attempt made to ligate the bleeding vessels.

PANCREAS

The pancreas is a fixed glandular organ situated in the lesser sac and rests on the

vertebral column. (Fig. 11.) It is well protected. It may be injured by blows in the epigastric region or by crushing it

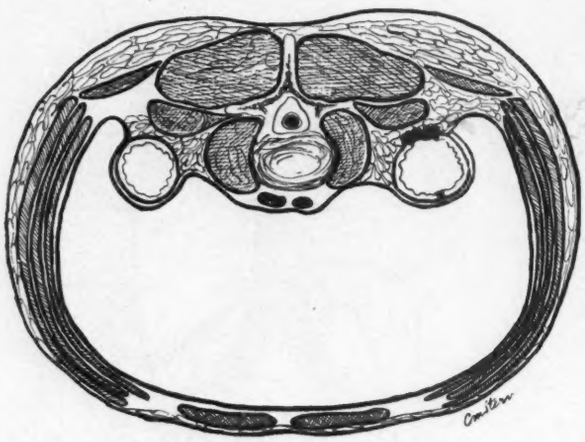

Fig. 20. Cross section anatomy of intra- and retroperitoneal lacerations of colon.

against the vertebral column. The lesions vary from tears in the head, body or tail, with or without involvement of the ducts, or a simple contusion. Hemorrhage into the substance or into the lesser bursa may result in cyst formation. (Fig. 12.)

Clinical Features. Severe shock is usually present. There may be excruciating pain in the epigastrium with formation of a mass above the umbilicus. A collection of ascitic fluid may be present. When objective evidence of intra-abdominal injury is absent or uncertain, an increase in the serum amylase level occasionally may be the earliest sign of injury to the pancreas.[67] The increase in the blood serum amylase following trauma to the pancreas probably results from the emptying of the injured acini and ducts into the interstitial spaces or into the peritoneal cavity or both.

Treatment. The pancreas is exposed by incising the lesser or gastro-colic omenta. The devitalized portion of the pancreas is removed and the divided ducts are ligated if not reparable. Lacerations of the pancreas are repaired with non-absorbable sutures. Soft rubber tissue drains are placed down into the injured pancreas. Cysts of the pancreas[42] are incised, emptied and marsupialized. (Fig. 13.)

STOMACH

The large size and the exposed position of the stomach renders it vulnerable to trauma. (Fig. 14.) The pathological condition may be limited to one or both walls, or include the curvatures with their highly vascular anastomoses. High explosive shells create jagged lacerations, whereas bullets result in small lacerations.

Clinical Features. Hematemesis and persistent retching are fairly constant findings. There is evidence of peritoneal irritation with either localized or diffuse pain, tenderness and associated rigidity. *X*-ray studies will reveal free gas in the peritoneal cavity.

Treatment. A left paramedian incision is utilized. Wounds of the cardia are difficult to expose and may require a transpleural approach supplemented by a phrenic nerve crush.

The wound edges are freshened, if necessary. Exploration of the posterior wall must not be omitted.[50] Insufficient exposure through the gastrocolic or gastrohepatic omenta, may call for enlargement of the anterior perforation to allow transgastric exposure and repair.[79] Wangenstein[99] has demonstrated in experimental animals that wounds up to 1 cm. in length are tolerated without mortality. The wounds are closed in layers with chromic catgut and the last layer with Lembert sutures. Gastroenterostomy is avoided but may be necessary in wounds of the pyloroduodenal junction.

SMALL INTESTINE AND MESENTERY

Injuries to the small intestine are fairly common and the resultant perforations are usually multiple due to the close proximity of the intestinal coils. (Fig. 15.) Frequent sites of rupture are the ileocecal junction and the duodenojejunal junction.[31] Mild trauma may rupture the intestine without any clinical signs for several hours. Signs of peritoneal irritation may not make their appearance until active peristalsis is reactivated, thereby resulting in leakage from the perforation into the peritoneal cavity.

Bullets usually produce small punctate wounds with eversion of the mucosa. (Fig. 17A.)

Wounds of the mesentery usually occur as complications of small intestinal wounds. Wounds of the mesentery may occur at the intestinomesenteric junction, in the midsection, or at its posterior attachment. (Fig. 16.) Extensive wounds at the intestinomesenteric border usually require resection of a triangular segment of small intestine.

Treatment. The most important principle is the finding and closure of all perforations. It is important to inspect the intestine adjacent to the perforation in order to decide whether to perform individual closures or resect a segment. The mesenteries are routinely examined when a large quantity of blood is present in the peritoneal cavity. A hematoma at the junction of the mesentery and intestine must be carefully examined for perforations, the hematoma evacuated, bleeding points grasped and tied.

1. Enterorrhapy is always preferable to resection. The intestine is closed in the transverse axis by means of a self-inverting Connell suture supplemented by a Lembert suture. (Fig. 17B.) A lateral anastomoses can be performed for narrowing of the intestinal lumen. (Fig. 17.)

2. Resection is indicated for destruction of large segments, for multiple large perforations within a short distance and for mesenteric injuries compromising the blood supply to the intestine. End-to-end resection with a double row of sutures is preferable since it can be readily and rapidly performed. (Fig. 18.) With ligation of the vessels of the mesentery there is the risk that an adjacent loop of intestine has been deprived of its essential blood supply and resection may be necessary beyond this doubtful segment. In cases of doubt, a small incision can be made in this questionable segment, free bleeding indicating a satisfactory blood supply.

Wise and Romansky[105] stated that in World War I there was no successful triple resection of intestines recorded. As much as one-quarter to one-half of the small intestine can be removed with safety.

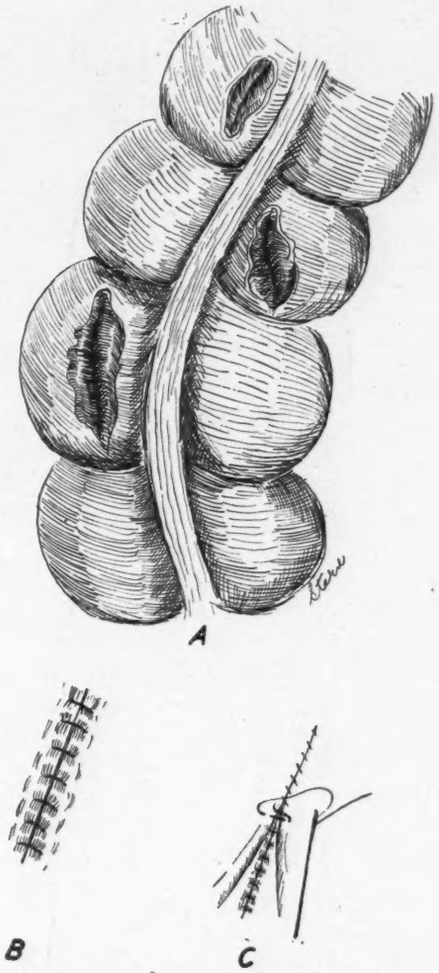

FIG. 21. A, lacerations of large intestine; B, first row of sutures; C, second row of sutures.

3. Exteriorization of the injured segment and double barrel enterostomy may be expedient in grave cases. Venostasis of the mesentery[20] is closely associated with ileus, therefore, tight bandaging of the abdomen is to be avoided in these cases.

DUODENUM

Injuries to the duodenum[32] are usually associated with other injuries. The duodenum because of its fixed position is vulnerable to crushing injuries which compress it against the unyielding vertebral column. *X*-ray studies of the duodenum

may reveal gas about the retroperitoneal tissues. Gas may be present between the transversalis fascia and the peritoneum,

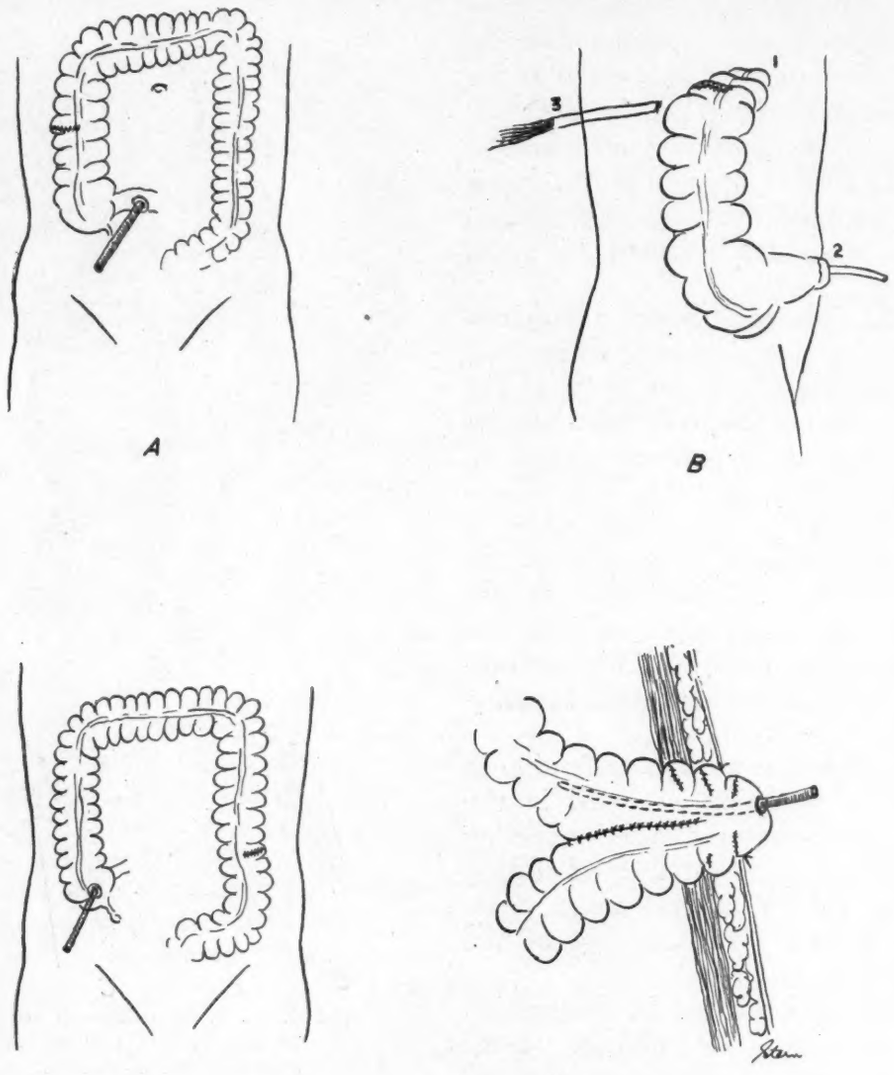

Fig. 22. A, repair of ascending colon and ileostomy; B1, repair of hepatic flexure, B2, cecostomy, B3, retroperitoneal drain; C, repair of descending colon and cecostomy; D, exteriorization of sigmoid and repair of lacerations.

and retroperitoneal crepitation may be palpated.[4]

Treatment. Exploration of the anterior and posterior surface and repair of the wounds. The posterior surface will require mobilization by means of a lateral incision along the outer border of duodenum and mesial retraction to expose its fixed retroperitoneal surface.

Suturing of small lacerations will suffice. If the duodenal lumen appears narrowed, a gastrojejunostomy may be necessary.

Complete tears or extensive lacerations may require a Pólya or partial gastrectomy with closure of the duodenum.

JEJUNUM

This segment is more commonly injured by penetrating wounds. The jejunum may rupture as a result of sudden compression of gas due to a blow or compression against the vertebral column.[52]

Gross soiling and board-like rigidity may not occur until twelve to twenty-four hours has elapsed after rupture of the jejunum.[3,52,58,71,76,86,96] This calm period is treacherous as it may obscure the diagnosis. The treatment is as described.

FIG. 23. A, rectal tears above and below line of peritoneal reflection; B, first row of sutures; C, second row of sutures.

LARGE INTESTINE

Wounds of the large intestine are less common and less multiple than wounds of the small intestine.[2] (Fig. 21.) Injuries may vary from isolated contused areas to large perforations and ragged tears. The cecum, hepatic and splenic flexures are frequently ruptured by non-penetrating trauma.[23]

The blood supply to the large bowel arrives from three major sources; the superior mesenteric, the inferior mesentery and the internal iliac branches. (Fig. 19.) The blood supply to the stomach and small intestine is so abundant that one may contemplate almost any type of resection without compromising the vascularity of the remaining tissues. This does not hold for the large intestine. Extreme care must be taken in the placing of ligatures when resecting parts of the large bowel in order that the remaining bowel will not be endangered by inadequate blood supply.[90]

A large portion of this tract is retroperitoneal and perforations are frequently overlooked. (Fig. 20.) Retroperitoneal colonic injuries with subsequent infection of the connective tissue planes and muscles of the posterolateral abdominal wall are much more fatal than intraperitoneal wounds.

Treatment. A paramedian incision may be enlarged by lateral extensions for wound

of the flexures, ascending and descending colon. Retroperitoneal injuries can be approached through a muscle cutting flank incision.

3. Exteriorization (Fig. 22D) is indicated in extensive wounds of the mobile segments of the colon. Mobilization is necessary in wounds of the fixed sections of the large intestine. The posterior surface of the colon without a mesentery is explored by opening the retroperitoneal space through a longitudinal incision in the peritoneum along the lateral border and reflecting the ascending or descending colon mesially. In addition to suturing of the posterior surface, closure of the peritoneum from within and establishment of a proximal colostomy, the retroperitoneal space is drained through a stab wound in the flank. (Fig. 22B.)

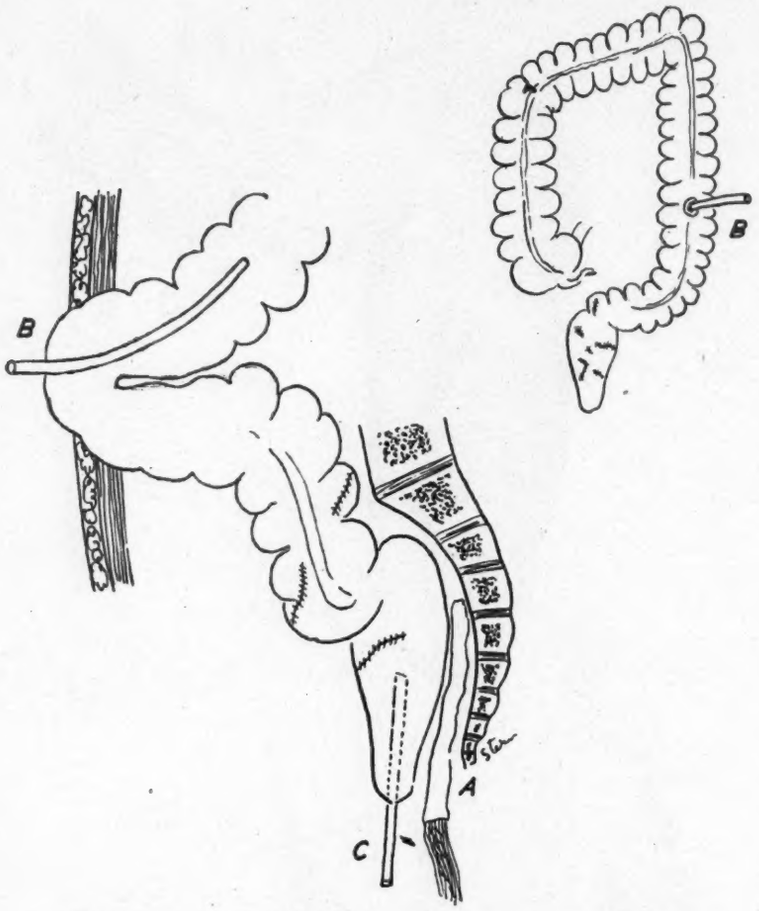

FIG. 24. A, retrorectal space; B, colostomy; C, rectal tube.

The treatment of colon injuries is based upon the known insecurity of sutures and the subsequent dangers of leakage.

1. Small tears may be sutured and covered with an omental graft. As a rule simple suture of large lacerations is unwarranted and dangerous.

2. Repair of lacerations and exclusion of the part by a proximal colostomy, cecostomy or ileostomy will provide for diversion of gas and fecal content. (Fig. 23A and B.) The colostomy should be brought out through a small separate incision. These small incisions hold the colon without sutures and allow rapid closure of the main incision. The colostomy may be allowed to function within a few hours after closure of the abdominal wall.

It is desirable to mobilize a long loop of the colon to facilitate its final closure. The two limbs of a well mobilized loop are approximated by a suture. The exteriorized colon should not be sutured to the ab-

dominal wall. A loop colostomy through the mesentery is preferable.

4. Extensive lacerations with loss of substance will necessitate a proximal colostomy to direct the fecal current and closure of the involved area. A second stage or definitive type of operation will be necessary at a later date.

Keene[49] advocates secondary end-to-end anastomoses of the disrupted colon at a later date.

RECTUM

Rectal examination is an important part of the physical examination and may reveal injury to the intraperitoneal, extraperitoneal segments, or both. (Fig. 23.)

Rectal wounds may be associated with wounds of the buttock, pelvis, flank and thigh. Gunshot wounds about the gluteal area, sacrum or coccyx require careful examination to rule out intraperitoneal injury.

Compressed air injected into the rectum may rupture the rectum.

Impalement injuries[24] are not uncommon. The frequency of injuries are favored by the funnel-like arrangement of the thigh surfaces, ischial tuberosities and soft parts around the anus; the anal canal being at the apex. The penetrating objects are directed to this apex, the anterior rectal wall and posterior bladder wall being frequently involved. Impalement of the rectum may occur directly through the anus or secondary after piercing the perineum.[100] The objects reported include pitchforks, picket fences, mop handles and horns of animals.[17] Impalement injuries may or may not injure the peritoneum.[78] The signs of peritoneal irritation may be slight or delayed. Perianal ecchymosis and lacerations may be coexisting.

Treatment. Laparotomy is indicated in all cases in which there is suspicion of peritoneal involvement. The following steps are carried out: (1) Débridement of the perineal wound, (2) repair of the bowel. The opening in the bowel is closed whenever possible, even though tears of the rectum below the peritoneal reflexion heal spontaneously. (3) Drainage of the retrorectal space. An incision lateral to the sacrum gives access to the pelvic-rectal cellular planes and permits drainage of the presacral space. (Fig. 24A.) (4) Colostomy. (Fig. 24B.) Wounds of the rectum, however trivial, require a proximal colostomy. A left inguinal colostomy is preferable. A transverse colostomy is utilized in rectal injuries that will require mobilization for its subsequent repair; thereby leaving the pelvic colon free and clear for the later operation. Prophylactic colostomy in perineorectal lacerations will prevent fistula formation. (5) Insertion of a rectal catheter will deflate the large intestine. (Fig. 24C.)

URINARY BLADDER

Wounds of the dome and posterior wall of the bladder are intraperitoneal, lead to peritonitis and may be complicated by wounds of the small intestine and pelvic colon. Extraperitoneal wounds involve the anterior wall, lateral walls and base of the bladder and may be complicated by compound fractures of the bony pelvis. The latter wounds are followed by urinary infiltration, destructive cellulitis and widespread necrosis unless drainage is promptly instituted.[89]

Clinical Features. Local pain is present if there is persistent extravasation of urine. A distended bladder suggests absence of leakage. Catheterization may reveal blood stained urine. Absence of urine is indicative of intraperitoneal extravasation.

Pathology. The lesions vary from small puncture wounds to extensive lacerations. Intraperitoneal lesions are often associated with injury to the small bowel or pelvic colon and frequently leads to peritonitis. Extraperitoneal lesions are often caused by a spicule of bone from a pelvic fracture and are associated with hematoma formation and urinary extravasation. The wound of entrance may be located in the sacral, gluteal and suprapubic areas, also in the hip, groin or perineum. Sometimes the punctures may be multiple and overlooked.

It is well to be sure that the dome of the bladder is not overlooked.[73] The causes of death are pelvic cellulitis, peritonitis and occasionally secondary hemorrhage from the pelvic vessels.

Treatment. Treatment combines the principles of wound excision and repair, supplemented by drainage of the bladder and cellular spaces of the pelvis.

The approach to the bladder is through a low midline incision extending to the symphysis pubis. Intraperitoneal wounds are sutured with two layers of catgut avoiding the mucosa.

Wounds in the rectovesical pouch may necessitate transvesical closure. Suprapubic cystostomy[81] will maintain constant bladder drainage. When bladder and rectal injuries are coexistent, cystostomy is performed prior to colostomy.

RETROPERITONEAL

Retroperitoneal hemorrhage may result from penetrating, non-penetrating, as well as "blast" injuries. These injuries may be limited to the retropertoneal spaces or be in combination with intraperitoneal lesions. Infection of the retroperitoneal tissues is severe and rapidly fatal due to the virulence of the anerobic flora.

Clinically there is pallor and progressive deterioration of the pulse without any evidence of peritonitis.[39] The pallor begins in the hands and subsequently extends to all exposed parts of the body. Various degrees of abdominal discomfort may be present with fleeting and inconstant abdominal tenderness and resistance.[36]

Hemorrhagic infiltration of the retroperitoneal tissues behind the parietal peritoneum, especially in the upper part of the abdomen, irritates the sympathetic ganglia and plexus. Ileus is quite common. Retroperitoneal hemorrhage usually absorbs without any treatment. Symptomatic treatment, of course, is indicated. Only when the hemorrhage appears to be increasing and shock deepening is operative intervention warranted. In the presence of infection operation is always indicated.

A hematoma may form rapidly or so slowly that it escapes notice until several hours after the trauma and therefore is unsuspected until pelvic cellulitis is fully established. Percussion dullness which does not shift with change of position is suggestive of retroperitoneal hematoma. The outer surface of the parietal peritoneum responds to irritation by the same mechanism and in the same manner as does its serosal lining.

Treatment. Conservative treatment is instituted if intra-abdominal injury can be ruled out. Hemorrhage from the large retroperitoneal vessels arising from the aorta and vena cava will require exploration and ligation of the bleeding points, with drainage of the retroperitoneal space.

An infected hematoma or a spreading cellulitis should always be incised widely to allow free drainage.

POSTOPERATIVE CARE

All patients with perforation of the gastrointestinal tract are treated as potential cases of peritonitis.[22]

Carefully recorded intake, output and electrolyte concentration with hematocrit and plasma readings will keep the patient in proper electrolytic balance and out of shock. Sedation, Fowler's position, oxygen inhalation and Wagensteen decompression with a Levine tube, or preferably a Miller-Abbott tube, are routinely instituted. 3,000 to 4,000 cc. of 5 per cent glucose in saline is administered intravenously every twenty-four hours. The necessity for whole blood transfusions will depend upon the hematocrit, red blood count and hemoglobin readings. Sodium sulfadiazine is administered intravenously, 6 Gm. daily, or sulfanilamide subcutaneously, using 150 cc. of an 8 per cent solution every six hours, a blood level of 8 to 10 mg. per cent being maintained.

Poth[77] and his associates favor the use of succinyl sulfathiazole, a maintenance dose of 25 mg. per kilo of body weight daily.

Penicillin[51] because of its rapid excretion, is given every three hours by the intra-

muscular route in doses of 30,000 Oxford units, if the organisms are susceptible thereto. Morphine, gr. ⅙, is given as often as necessary to control pain.

The Fowler position is used so that all drainage will go into the pelvis, where there is little motion and where abscesses can be readily drained.

POSTOPERATIVE COMPLICATIONS

Wound infection, peritonitis, pelvic abscess, subphrenic suppuration, retroperitoneal suppuration, postoperative atelectasia and thrombophlebitis are common sequellae to abdominal injuries. Their appearance is to be anticipated, so that sound rational therapy can be instituted at once.

CONCLUSION

Early recognition and immediate treatment of non-penetrating and penetrating abdominal injuries are essential.

The institution of shock therapy is preferable as a prophylactic rather than a therapeutic measure. Shock therapy always precedes surgical exploration unless there is continuous bleeding.

Preoperative preparation, the question of anesthesia, incision and operative procedures are discussed.

The operative technic cannot always be standardized and will depend upon the condition of the patient, the existing facilities and the multiplicity and severity of the injuries.

Wound closure, with or without drainage, and postoperative care is reviewed with firm emphasis upon the prophylactic use of penicillin and chemotherapy.

A plea is again made for the early recognition of postoperative complications and their immediate treatment.

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VARICOCELE*

FRANCIS A. BENEVENTI, M.D.
NEW YORK, NEW YORK

VARICOCELE is a varicosity of the pampiniform plexus and should be considered as detrimental a process to the testicle as varicose veins are to the lower limbs. It is a young man's ailment and rarely makes its initial appearance after the third decade of life. It is sometimes asymptomatic but usually such symptoms as low back pain, dull pains in the perineum and groin, feeling of weight and heaviness and sometimes sharp pains in the testicle are the chief complaints. In varicoceles of long duration the testicle on the affected side is considerably smaller than its mate on the unaffected side. This can be explained on the basis of poor circulation to the involved part. It has been the cause for rejection from positions which required fairly rigid physical examinations in civilian life and particularly in Civil Service.

HISTORY

The old operation of attacking the varices in the pampiniform plexus in the scrotum was unsatisfactory for several reasons: (1) The postoperative formation of fibrous tissue about the ligated venous stumps was bulky and heavy and was in many instances as offending as the original variocele; (2) postoperative hematomas were common; (3) postoperative hydroceles (when the combined operation of excising the tunica vaginalis as well as the veins was not done) required further surgical intervention; (4) failure to correct the condition completely. The operation for the cure of varicocele was consequently not looked upon with favor and in a majority of cases it was shunned.

Two of our South American neighbors interested themselves in this subject and Bertola, in 1940, reported good results by separating the internal spermatic vein and its branches from the cord in the inguinal canal and transfixing these to the neighboring muscles. In work reported in 1941 and 1942 Bernardi developed an inguinal operation whereby the internal spermatic vein and its branches were ligated and cut at the internal inguinal ring through a 3 to 4 cm. skin incision. He reported seventeen cases with four immediate failures which he attributed to overlooking small accessory veins. Reoperation was successful in three of these cases and the fourth refused secondary operation. In 1944, Rudie employed the principle of venous ligation and the injection of sclerosing solution with good results. He exposed the spermatic cord through a small inguinal incision, ligated and excised a small segment of vein and injected the distal stump with 1 cc. of 5 per cent sodium morrhuate solution. During the same year Zucker reported good results by ligating the varices in the cord and transfixing them to the internal oblique muscle. Again in 1944 Javert and Clark in a preliminary report described a combined operation for varicocele and inguinal hernia. They found that of a series of 145 patients with varicocele, 25 per cent had an associated hernia. "Moreover, ten patients with varicocele and without a clinical hernia, had a hernial sac of varying size at operation, an incidence of 100%." They treated the varicocele by ligating the internal spermatic vein in the inguinal canal and the hernial sac was dealt with in the usual manner. The reports of all these investigators were uniformly good;

*During the preparation of this paper, Dr. Beneventi was on active duty in the Medical Corps of the U. S. Naval Reserve. These are collected cases from Naval Dispens., Navy #120, and U. S. Naval Hospital at Shoemaker, California, approved by the Bureau of Medicine and Surgery, U. S. Navy.

the patients remained symptomless and the varicoceles had vanished.

During the early months of 1945 we operated on fourteen patients with large symptomatic varicoceles at a U. S. Naval Hospital in the tropics, and later on we operated on another fourteen patients at the U. S. Naval Hospital, Shoemaker, California; a total of twenty-eight cases. These were all done via the inguinal route, employing the principle of preventing venous backflow into the pampiniform plexus by ligating the internal spermatic vein in the inguinal canal at the internal ring. The purpose of this paper is to report on our experience, the incidence of associated hernias and the postoperative progress of these twenty-eight young sailors who were operated upon for large symptomatic varicoceles. The age range in this series was eighteen to thirty-one; three were thirty-one. The type of operation we employed was a combination of steps taken from operations previously described with some modifications, plus the use of the modified Bassini type of hernioplasty for reconstructing the inguinal canal.

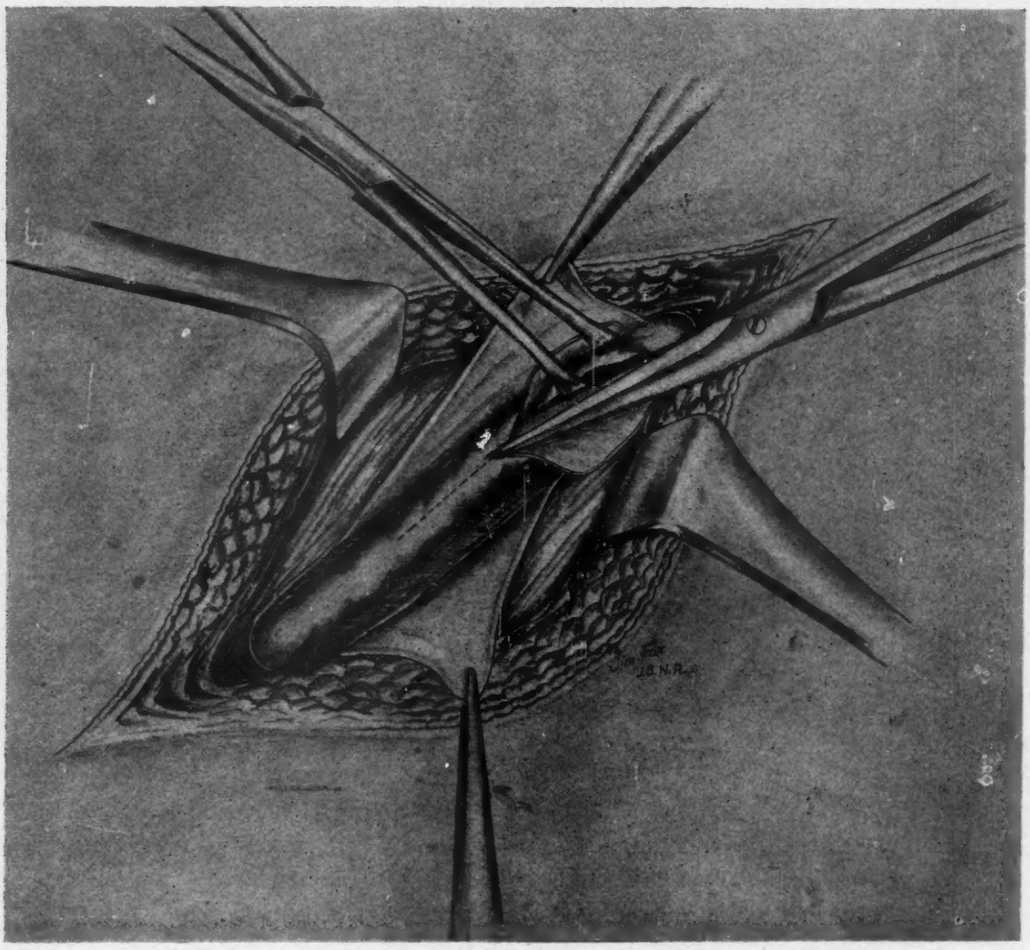

Fig. 1. Cut edges of the external oblique aponeurosis are retracted and the inguinal canal and spermatic cord are exposed. Cremasteric fascia is incised; Allis forceps on contents of cord; external ring not opened.

OPERATION

Through a three-inch inguinal incision running slightly above and parallel to Poupart's ligament, the skin, subcutaneous tissue and Scarpa's fascia are incised and retracted from the underlying external oblique aponeurosis. The external ring and the cord emerging from it are identified. An incision is then made in the aponeurosis along the course of its fibers commencing

at a point about 1 cm. lateral to the ring, thereby leaving the arcuate fibers of the external ring intact. The cut edges of the external oblique are retracted and the inguinal canal and its contents are exposed. The cremasteric muscle is then incised and the elements of the cord are separated. In order to preclude injury to the vas deferens and the internal spermatic artery, these structures are first identified and retracted out of the field of operation. The enlarged and distended internal spermatic vein or veins are easily identified and bluntly separated from the surrounding structures. Careful search is then made for the presence of a hernial sac in the region of the internal ring. High ligation and excision is then carried out if one is found. If some slack is found in the transversalis fascia, this is taken up with two or three sutures. The transversalis fascia and the conjoined tendon are then sutured to the shelving edge of Poupart's ligament. Kocher clamps are then placed on the offending veins and a one inch segment of vein is excised. The stumps are ligated and the ends are bound together. A needle is then threaded on the long ends of the ligature and the obliterated veins are sutured to the under surface of the internal oblique muscle. The elements of the spermatic funiculus are then reposited on the newly constructed floor of the inguinal canal, and the cut edges of the external oblique aponeurosis are either approximated or imbricated.

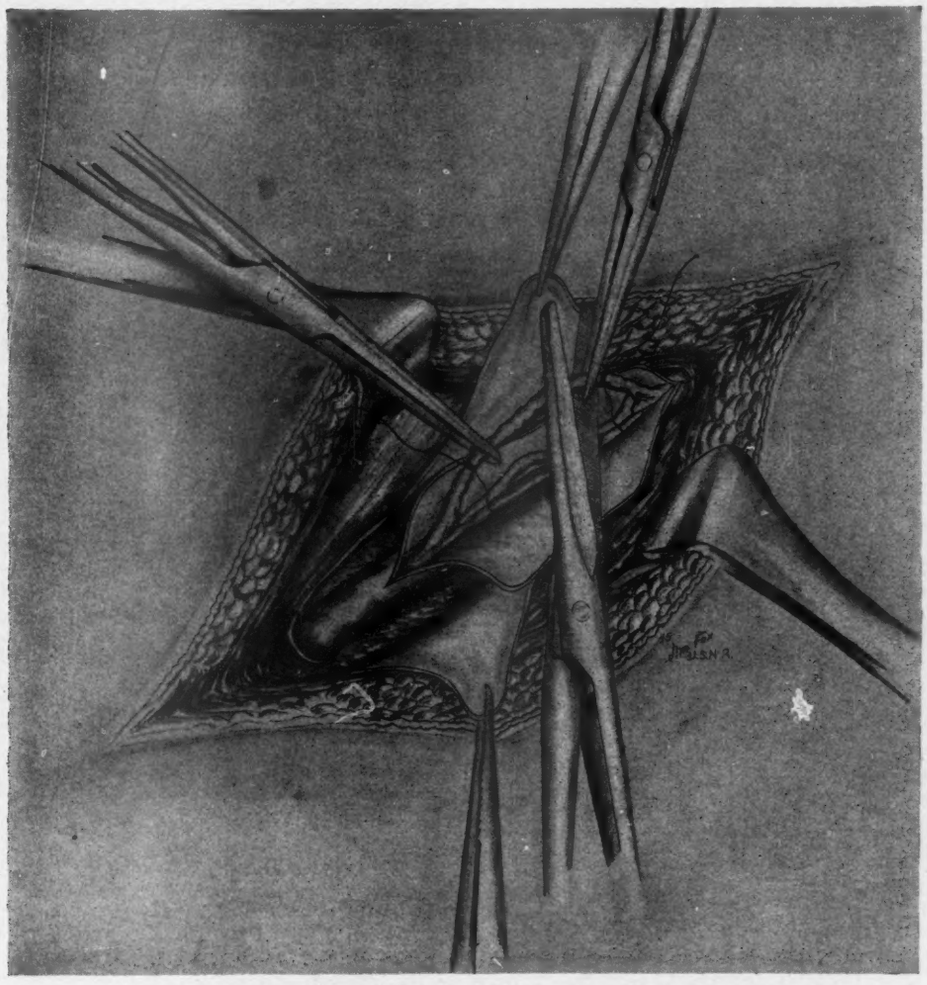

Fig. 2. Internal spermatic vein is isolated, ligated and a one-inch segment is excised.

After the patient is placed in bed the testicles are supported by strapping a broad strip of adhesive tape across the

upper thighs. When no hernial repair has been necessary, the patient is allowed out of bed on the second or third day. When the combined operation has been done, the patient is allowed to remain in bed for six days. Patients are sent to duty in from ten to twenty days postoperatively. It might be well to point out at this time that the internal oblique muscle does not play a part in the reconstruction of the new canal on the grounds that satisfactory union is not had when "red" muscle tissue is sutured to "white" fascial tissue. Herniotomists of long experience have stressed the importance of uniting only" white" fascial tissue to "white" fascial tissue in order to obtain the good firm union so vital to the success of inguinal reconstruction. Our experience with the use of cotton suture material has been very satisfactory. Tissue reaction and postoperative wound induration have been minimized by its use.

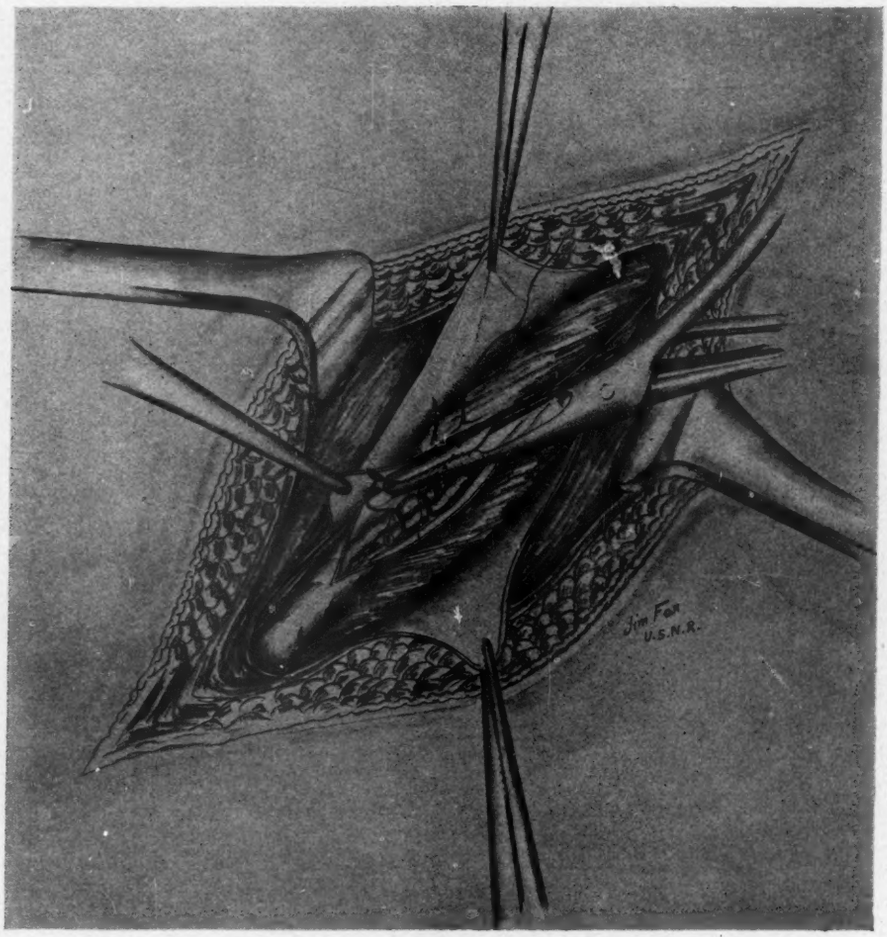

Fig. 3. Ligated stumps of the internal spermatic vein are bound together and transfixed to the under surface of the internal oblique muscle.

PERTINENT OPERATIVE FINDINGS

1. The internal spermatic vein was very often found doubled or bifurcated.

2. The internal spermatic artery (a branch of the abdominal aorta) was closely associated with the veins in the cord and great care must be exercised to avoid injuring it.

3. The external spermatic artery (cremasteric), a branch of the inferior epigastric, is distributed in the elements of the sheath of the cord. It is the chief source of bleeding in manipulating the cord.

4. A small indirect incomplete hernial sac was found in eight patients, seven of these being in the older age group (twenty-

eight to thirty-one). All had large varicoceles of from five to twelve years' duration.

5. The external ring was allowed to remain intact unless it was unduly relaxed.

DISAPPEARANCE OF PREOPERATIVE SYMPTOMS AND POSTOPERATIVE COURSE

1. *Preoperative Backache.* Backache vanished within twenty-four hours in sixty per cent of the patients who had this symptom before operation.

2. *Preoperative Sharp Testicular Pains.* These pains disappeared within twenty-four hours in two cases and did not recur within the postoperative period for two months.

3. *Preoperative Perineal and Groin Pains.* These pains vanished within twenty-four hours in three patients and did not recur in one month's postoperative observation.

4. *Postoperative Testicular Tenderness.* Seventy per cent of patients experienced testicular tenderness for a short postoperative period. Tenderness remained anywhere from two to fourteen days. Two patients experienced exquisite tenderness for four days.

5. Postoperative complications such as hydrocele, hematoma or testicular atrophy have been non-existent.

6. The varicocele completely vanished in from four to eight days in all cases.

CONCLUSIONS

1. The treatment of varicocele by inguinal ligation of the internal spermatic vein is based on sound anatomical and physiological principles and is the operation of choice.

2. Eight patients in twenty-eight had an associated inguinal hernia. These patients were in the older age group an incidence of 29 per cent.

3. The postoperative course is short and attended by a temporary period of testicular tenderness.

4. Cotton suture material has been used with a great deal of satisfaction.

5. Our experience and that of other investigators attests to the fact that satisfactory operation without disturbing complications can be assured in almost every case of varicocele.

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MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF THE FEMUR BY SKELETAL TRACTION WITH THE BEADED KIRSCHNER WIRE*

HENRY BRIGGS, M.D. AND SIDNEY KEATS, M.D.

Chief of Orthopedic Service, Orange Memorial Hospital — Resident Surgeon, New Jersey Orthopaedic Hospital

EAST ORANGE, NEW JERSEY

FRACTURES of the femur constitute a most important group of fractures, often associated with a high percentage of disability. The functional importance of the lower extremity is primarily that of weight bearing, and the shifting of weight bearing, namely, locomotion. Strict attention to functional anatomy is essential in the treatment of fractures of all types, and in the lower extremity of utmost importance. Every effort should be made to secure careful anatomical restoration of the parts in intertrochanteric fractures as well as in fractures of the neck of the femur.

In the past, the treatment of trochanteric fractures has often been neglected. It has been common understanding that, due to the vascularity of this area, these fractures can be handled by almost any method and healing will ensue. It is true that ultimate union is almost certain. However, malunion, with subsequent disability, has been fairly common, and the mortality from indifferent treatment unnecessarily high. With full effort directed at achieving maximum anatomical restoration, and with realization of the importance of the geriatric problems involved, we have treated a number of intertrochanteric fractures of the femur with skeletal traction employing the beaded Kirschner wire.

Intertrochanteric fractures are peculiar to elderly patients over the age of fifty. They constitute a high percentage of all the fractures of the femur. In a series of 526 cases of fractures of the femur reported by Speed, 124 were fractures of the neck, while 118 cases were fractures in the intertrochanteric region. Fractures of the trochanteric area result chiefly from trivial injuries, such as slipping or stumbling in the home, or on the street, the patient striking on the hip, or sustaining the fracture by what appears to be torsion, without direct violence to the trochanteric area. Intertrochanteric fractures are almost never compound. Separation of the fragments is not common, impaction of some degree being the rule. Displacement is usually present and produces a coxa vara deformity. This deformity is the result of separation of the fragments in the region of the greater trochanter with hinging of the fragments at the inferior end of the intertrochanteric line near the lesser trochanter. Outward rotation of the distal fragment, in relation to the upper, is common because these fractures are usually extracapsular. The lesser trochanter is frequently involved as a separate fragment, and is usually displaced upwards by the iliopsoas muscle. There may be considerable shortening due chiefly to a flattening of the neck angle.

PATHOLOGY

In our group of cases, several types of fractures were distinguished. The *first* of these, were fractures through the base of the neck of the femur, but outside the capsular attachment. Displacement was usually slight, and coxa vara deformity infrequent. In the *second* type, the fracture extended from the tubercle of the femur obliquely downward and medially along the intertrochanteric line. The distal fragment was rotated outwards and a gap appeared between the two fragments, with the angle opening upwards. Coxa vara of a

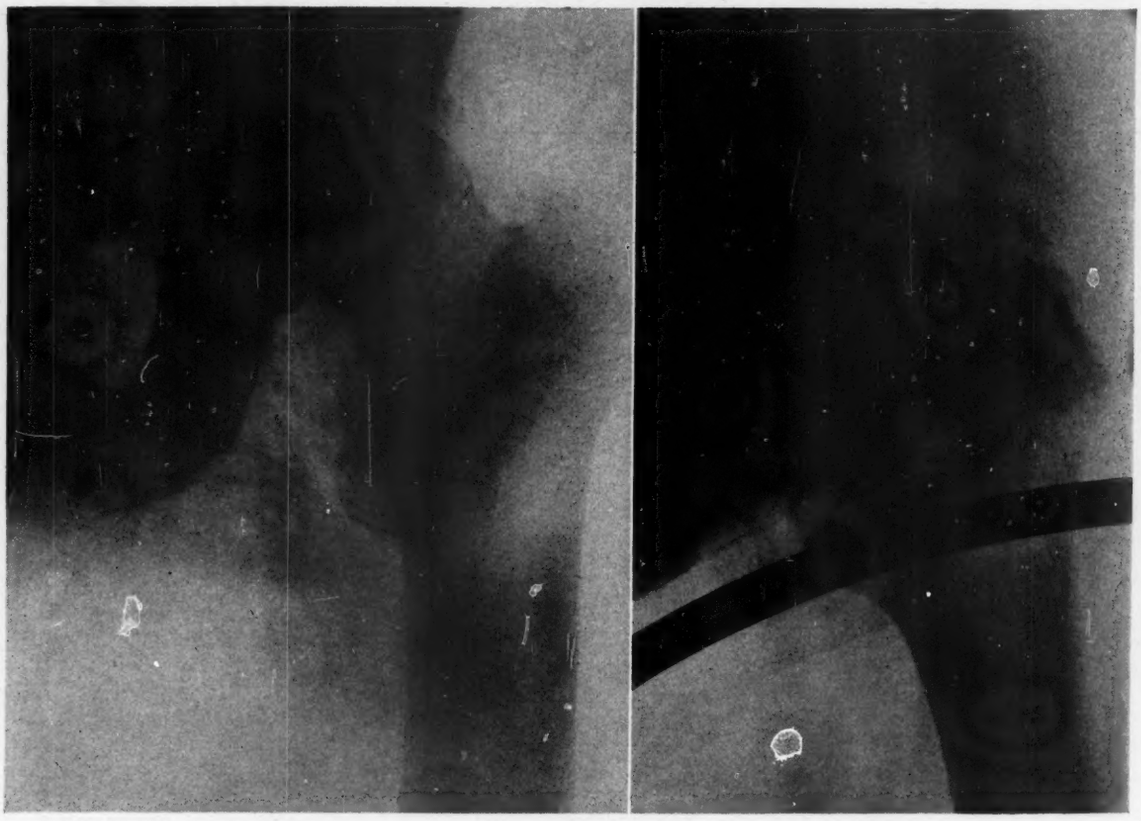
* From The Orange Memorial Hospital and The New Jersey Orthopaedic Hospital, Orange, New Jersey

TABLE I

ANALYSIS OF EIGHTEEN CASES TREATED BY TRACTION WITH BEADED WIRE

Case	Sex	Age (Years)	Type of Fracture	Complications on Admission	End Results		Remarks
					Anatomical	Functional	
1. A. M.	Male	44	III	None	Bony Union Mild Coxa Vara	Good	
2. C. S.	Female	72	II	Carcinoma of the Stomach. Hypertensive Cardio-Vascular Disease. Malnutrition	Bony Union	.....	Died after 47 days of Congestive Heart Failure
3. E. S.	Female	76	V	None	Bony Union	Good	
4. E. M.	Female	80	III	None	Bony Union	.....	Died after 57 days of a Pulmonary Embolus
5. J. W.	Female	91	I	Basal Cell Epithelioma of Forehead	Bony Union	Good	
6. K. M.	Female	83	III	Arteriosclerotic Cardio-Vascular Disease. Umbilical Hernia	Solid Bony Union	Good	
7. E. R.	Female	65	III	None	Bony Union	Good	
8. D. K.	Female	68	I	None	Bony Union	Good	
9. S. D.	Female	80	V	Chronic Nephritis	Bony Union	.....	Died after 128 days of Congestive Heart Failure
10. M. F.	Female	78	III	None	Bony Union Mild Coxa Vara	Fair	
11. K. H.	Female	68	III	Arteriosclerotic Cardio-Vascular Disease. Diabetes Mellitus	Bony Union	Good	
12. C. M.	Female	55	III	None	Solid Bony Union	Good	
13. G. H.	Male	76	V	None	Bony Union	.....	Died after 150 days of Bronchopneumonia
14. A. S.	Female	82	V	Subcapital Fracture Opposite Femur	Solid Bony Union	Good	Subcapital Fracture. Fixed with Smith-Petersen Nail. Patient discharged on crutches after 119 days.
15. J. V.	Male	84	I	None	Bony Union	Good	Slight amount of sero-purulent drainage from pinholes; ceased after short course of penicillin therapy.
16. V. P.	Female	85	IV	Hypertensive Cardio-Vascular Disease	Solid Bony Union	Good	
17. M. E.	Female	78	I	None	Bony Union	Fair	Wire removed because of large decubitus ulcer and pin drainage. Roger Anderson Well-Leg traction applied at 43 days.
18. M. L.	Female	80	I	None	Solid Bony Union	Good	

slight degree was usually present. In the *third* and commonest type, the base of the neck of the femur was driven into the spongy mass of the trochanters. Extreme coxa vara was produced with marked outward rotation of the distal fragment. The lesser trochanter was frequently avulsed and separated from the main bony mass. In the *fourth* type, the fracture line involved both the intertrochanteric and subtrochanteric regions. There was hinging of the fragments with downward and medial displacement of the upper fragment, the gap opening laterally. This type of fracture has commonly been designated as the pertrochanteric fracture. The *fifth* type of fracture encountered, was similar to the previous type, with the addition, however, of avulsion and separation of the lesser trochanter. The shaft of the femur was frequently displaced upwards.



A B

FIG. 1. A, Case 15, J. V., aged eighty-four, illustrating a Type 1 intertrochanteric fracture, with fracture through the base of the neck outside of the capsular attachment. B, healing progressing with slight displacement and absence of coxa vara.

CLINICAL FEATURES

There are several clinical features which mark these fractures. The patient, usually elderly, may complain of immediate pain in the hip, and inability to rise or stand on the limb. There are patients, however, who have been able to walk on the injured extremity. Examination of the limb will reveal the extremity in a position of marked external rotation, the degree of rotation being limited only when the foot is flat on the bed on its outer side. This is in contrast to the intracapsular fracture of the neck of the femur, where the tendency toward outward rotation is limited by capsular resistance. Mensuration of the limbs will show a shortening of the injured side of rarily more than one-half to one inch. There will be tenderness over the trochanter, which will be found to be lying well above Nélaton's line.

METHOD OF TREATMENT

Intertrochanteric fractures of the femur in the aged and debilitated are often terminal events. Many of these patients will die regardless of the method of treatment. In those who survive, healing of the fracture will invaribly take place. With improper treatment, however, malunion and coxa vara will take place, leaving the patient crippled and bed-ridden, or entirely dependent upon crutches. Every effort should be directed at preventing any deformity which will handicap these elderly individuals who are, at their best, scarcely able to compensate for bony disproportion as well as the younger and more robust individual. The anatomical result of the treatment of any fracture is proportional to the accuracy of the primary reduction, the maintenance of that reduction, and the protection of the primary union against the elements of muscle spasm tending to cause displacement and rotation.

After a trial of the various methods of treatment of these fractures, we prefer skeletal traction by means of a beaded Kirschner wire inserted through the femur just above the condyles. The beaded wire employed is that used by Pease in the closed reduction of fractures of the tibia. It consists of a metal bead, five thirty-seconds of an inch in diameter, which is brazed to a plain Kirschner wire. Primary reduction is accomplished by traction in moderate abduction and internal rotation. The beaded wire is inserted through the medial aspect of the femur, and internal rotation is maintained by oblique traction attached to the wire, the bead preventing the wire from being drawn through the femur, also giving adequate purchase to the rotatory force, and preventing the wire from slipping from side to side.

Careful attention is given to the technic of insertion of the beaded wire, in order to avoid necrosis of the bone, and ulcera-

FIG. 2. A, Case 2, C. S., aged seventy-two, demonstrating a Type II intertrochanteric fracture. The fracture extends from the tubercle of the neck obliquely downward and medially along the intertrochanteric line. The distal fragment is rotated outwards and a gap appears between the two fragments with the angle opening upwards. B, showing healing after forty-seven days of skeletal traction with the beaded Kirschner wire. Coxa vara deformity is present. The patient died of congestive heart failure subsequent to a rather extensive carcinoma of the stomach. Traction was maintained with difficulty because of senile delirium.

tion of the skin. The skin is shaved, and then cleansed with soap and water, and alcohol. The field is painted with iodine and alcohol, and adequately draped with sterile towels. Sterile gloves are always worn. A point on the skin about three-fourths of an inch proximal to the medial femoral condyle is chosen, and a bleb raised with 1 per cent novocaine. The wire should not be driven through the condyles because of the soft cancellous nature of the bone in that area tending toward bony necrosis when traction is applied. An incision about one-quarter of an inch in size is made in the apex of the bleb. The skin is then pulled upward on each side while novocaine is injected down to and into the periosteum. The upward traction is made until the wire is fully inserted. The wire is driven through from the medial aspect of the femur by means of a cannulated hand drill. It is not possible to use the ordinary telescopic guide for the insertion of the wire because of the bead brazed on the wire. In order to steady the wire, and avoid unnecessary motion, it is possible to insert the wire into the cannulated hand drill to a point where only a few inches of the wire is exposed at any one time. We have found the hand drill preferable to the motor drill for the insertion of the wire. It is possible to wind up the common peroneal nerve around the wire when the motor drill is used. When the point of the wire bulges through the skin on the opposite side, a second novocaine wheal is raised and the skin is again incised. The wire is inserted slowly until the bead meets resistance against the medial cortex. The tissues are then allowed to retract, and so pull away from the pin's inferior surface, minimizing the pressure on the soft tissues when traction is applied. No collodion or dressings are applied to

Fig. 3. A, Case 12, C. M., aged fifty-five, illustrating a Type III intertrochanteric fracture. The base of the neck appears driven into the spongy mass of the trochanters. The lesser trochanter is avulsed and separated from the main bony mass. Coxa vara deformity exists. B, demonstrating healing of the base fracture and early union of the lesser trochanter. No special effort was made to approximate the avulsed lesser trochanter.

the skin about the pin. We have discovered through experience that the pin holes are sealed off very quickly by coagulation of patient recovered from the initial shock of the injury. Then skeletal traction was employed as described. The traction force

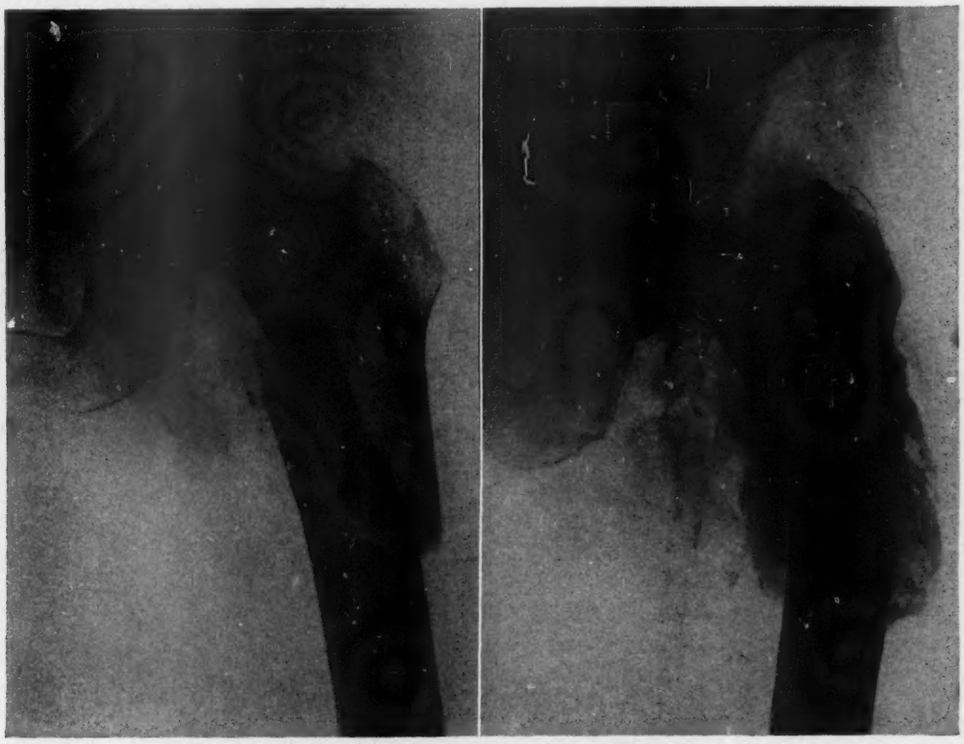


Fig. 4. A, Case 16, V. P., aged eighty-five, demonstrating a Type IV fracture. The fracture line involves both the intertrochanteric and subtrochanteric areas. There is hinging of the fragments with the gap opening laterally. B, illustrating healing with an abundance of bony callus. The patient's course was complicated with hypertensive cardiovascular disease.

serum, and that any dressing applied to the skin will only cause maceration and sloughing of the skin edges. In addition, the region about the pin is always available for inspection. A stirrup is applied with traction maintained in a vertical direction. In addition, separate traction to obtain internal rotation is maintained by applying the end of a separate rope to the lateral extension of the wire, internal to the attachment of the stirrup, and exerting this force by added weights in medial oblique direction.

This type of traction has been found extremely satisfactory in overcoming the displacement and the outward rotation of the shaft of the femur, and in the majority of cases, almost perfect anatomical reduction has been obtained. In several cases, we have applied the Russell type of adhesive traction for the first few days, while the necessary at the beginning, is usually about twenty to twenty-five pounds, but after several days, the weight can be reduced to fifteen pounds, with four to six pounds for internal rotation. The thigh and leg are supported on pillows.

By this method of treatment, special attention may be given to medical supervision and nursing care, as well as the treatment of the fracture. This is of utmost importance in the handling of these patients, who commonly present nervous, cardiac, vascular, renal and other complications. The trunk and back are left entirely free, and the patient may be propped up in bed with a back support, and may shift at will from side to side. With frequent changes in position so feasible, hypostatic pneumonia can be avoided. The skin of the back and buttocks is easily accessible and can be easily cared for,

avoiding bed sores. Active and passive mobilization of the knee may be started early and continued during the entire course of treatment. This advantage is of considerable importance in cutting down the period of disability, inasmuch as painful stiffness of the knee is one of the more common causes of permanent disability in the elderly patient following immobilization of the lower limb, regardless of the method employed. We prefer skeletal over adhesive traction as a method of obtaining traction, since it is not possible to obtain the necessary internal rotation of the shaft fragment by skin traction, and, too, considerably less weight is necessary for the reduction and the maintenance of position. In addition, the patients are more com-

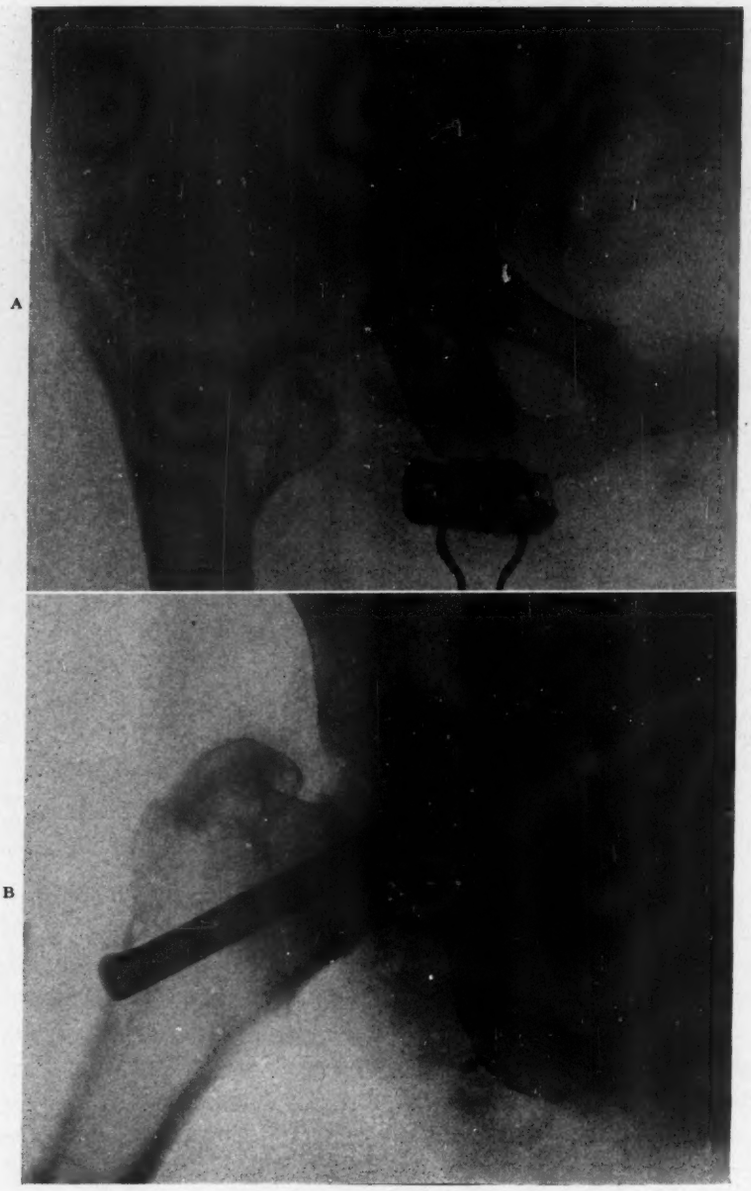


FIG. 5. A, Case 14, A. S., aged eighty-two, illustrating the Type V intertrochanteric fracture. This is similar to a Type IV fracture, with the addition, however, of avulsion and separation of the lesser trochanter. B, this patient also had a sub-capital fracture of the neck of the femur on the other side. The neck fracture was fixed with a Smith-Petersen nail. The patient was discharged on the 119th day on crutches.

fortable, and stiffness of the knee is avoided. Skeletal traction is maintained for from eight to ten weeks, following which, the patient is permitted to sit up in a wheel chair. Weight bearing is not allowed for a period of six months, even though the *x*-ray usually shows evidence of abundant callus. The presence of such plentiful callus is misleading, and if weight bearing is permitted too early, the soft callus will bend, and coxa vara will develop, with considerable external rotation deformity and shortening of the limb.

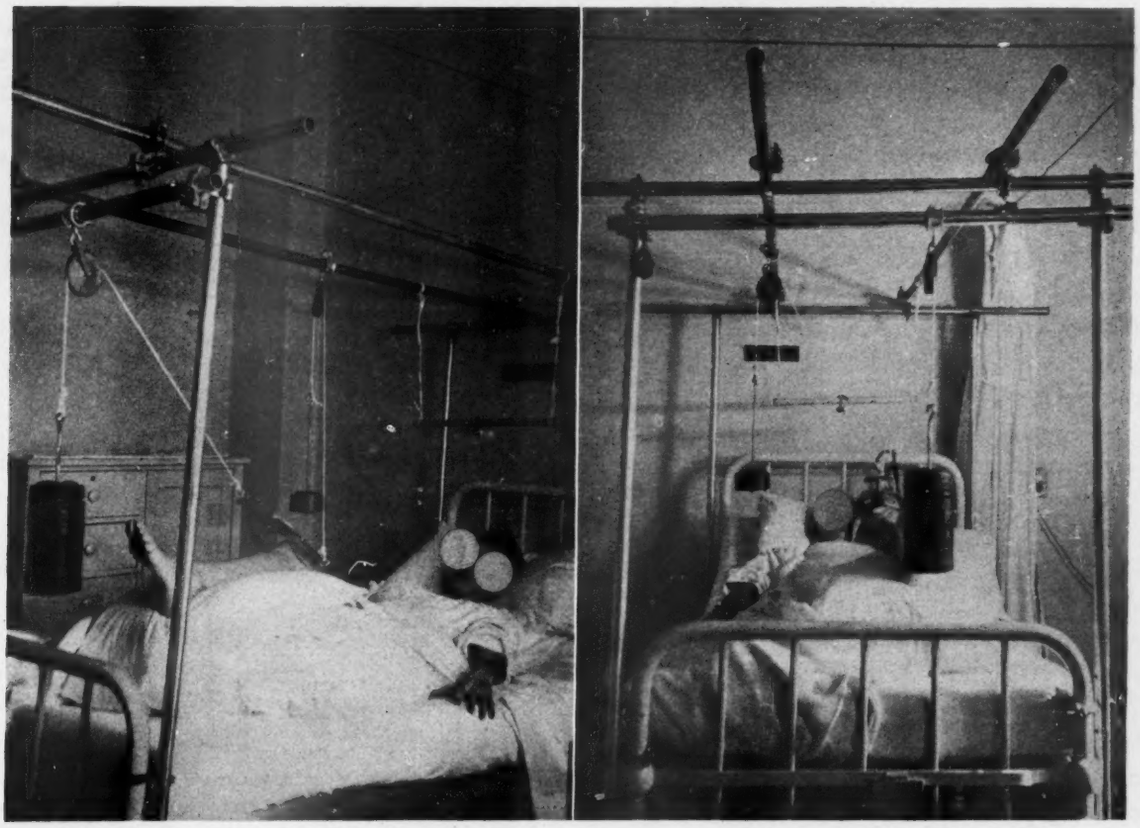


Fig. 6. Illustrating the beaded Kirschner wire traction in the treatment of intertrochanteric fractures. The wire has been inserted through the femur just above the condyles. Traction is maintained in a vertical direction, and in an oblique mesial direction to produce internal rotation. Note the support of the thigh and leg by pillows. The patient is comfortable and can be moved with ease without disturbing the forces of traction.

ANALYSIS OF CASES

This review is based on a study of thirty-two cases of intertrochanteric fractures of the femur, seen during the past two years, eighteen, or 56 per cent, of which, were treated by skeletal traction with the beaded Kirschner wire. Our analysis showed good functional results and excellent anatomical restoration in sixteen of the cases with bony union in every case.

The age distribution of the patients varied from forty-four to ninety-one years, with an average age of 74.7 for the entire group. Of these, fifteen were female, and three were male patients. The youngest case was a man of forty-four, and the oldest male patient, eighty-four. The average age for males was sixty-eight years. Of the women, the youngest was fifty-five years of age, and the oldest ninety-one; the average age being seventy-six.

The incidence of the five types of fractures as previously described, proved to be as follows: Type I—incomplete, extracapsular, base of the neck or without deformity —five cases; Type II—intertrochanteric

only—one case; Type III—intertrochanteric with avulsion and separation of the lesser trochanter—seven cases; Type IV—pertrochanteric—one case; Type V—pertrochanteric, plus avulsion and separation of the lesser trochanter—four cases.

Complications of a medical nature commensurate with the age range of these patients were rather frequent. Four of the cases were burdened with cardiovascular disease. One patient was admitted with rather advanced carcinoma of the stomach, another a basal cell epithelioma of the skin of the forehead, and still another patient was a severe diabetic. Patient A. S., age eighty-two, had incurred a subcapital fracture of the neck of the opposite femur, in addition to a rather severely comminuted, Type V intertrochanteric fracture. This subcapital fracture was treated by fixation with a flanged Smith-Petersen nail under local anesthesia, and the intertrochanteric fracture was reduced and immobilized by traction with the beaded Kirschner wire. The latter patient was discharged on crutches after 119 days of hospitalization. It should also be noted that the majority of our patients were ward cases, many of whom were in a subclinical state of malnutrition.

The prognosis for intertrochanteric fractures has often been shown to depend chiefly upon the general condition of the individual patient. If the patient's general condition will permit recovery from the initial shock of the injury and the long confinement inherent in the treatment, the prognosis for the fracture is invariably good. Four (or 22.2 per cent) of our patients died. This mortality agrees closely with that of P. D. Wilson, and that quoted by Speed. The average age of the patients who died was seventy-seven years.

SUMMARY

Intertrochanteric fractures of the femur are common fractures in the older age groups, and often upset the delicate hold that these patients have upon life, resulting in terminal complications. For those who survive the initial injury, healing of the fracture will take place. To prevent the bony disalignment and the deformity which results in the total, often terminal, confinement of these patients to wheelchairs and beds, every effort should be made to achieve complete anatomical restoration. Careful medical and nursing supervision is imperative, too. We have described a most successful method of handling these fractures by the reduction and immobilization of these fractures with skeletal traction employing the beaded Kirschner wire.

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INGUINAL HERNIORRHAPHY FROM THE INTRA-ABDOMINAL PERSPECTIVE

RETENTION OF THE SAC AND INTACT EXTERNAL RING, AND A MEANS FOR PROVING THE ADEQUACY OF THE REPAIR

PHILIP JACOBSON, M.D.
Attending Surgeon, Petersburg General Hospital
PETERSBURG, VIRGINIA

THE prevailing procedures for the cure of inguinal hernia emphasize the necessity for high ligation and complete removal of the sac, followed by reconstruction of the abdominal wall. The operation is done somewhat categorically in accordance with the type of hernia, and the erection of a barrier strong enough to prevent recurrence is the dominating thought. Under such circumstances there can be little individualization since the operation usually follows the pattern already prescribed for the group to which the hernia belongs. Every case, however, is a problem in physics and mechanics but without benefit of any means of measuring anatomical variations and constitutional deficiencies.

The literature on this subject is so replete because, without a suitable guide for each separate case, attention is centered on discovering what can be relied upon to remedy approximately similar anatomical defects. No provision is made for deciding during each operation what, if anything, must be done, nor at the conclusion whether the erected barrier will be adequate. It is possible that if a test for its success could be made so the outcome could be known with reasonable certainty, the surgeon would be less likely to depend upon any favored method. Neither would he have to wait for the passage of time, after it is too late, to approve his efforts. If the abdominal approach is used, such a trial is possible. Moreover, the class of hernia would make little difference since the peculiarities of each one, considered as a separate and distinct entity, could be discovered immediately upon entering the abdomen.

The object of this communication is to consider inguinal hernias and their repair from the perspective of the same force which creates them. This is a reversal of the commonly accepted practice which, while acknowledging that the intra-abdominal pressure pushes the viscera through the abdominal wall, nevertheless completely ignores the effect of this force before and after the repair is completed. Thus no attempt is made to demonstrate the arrangement of the tissues with the intra-abdominal pressure in actual operation nor what rearrangement of these structures will take place, and how and where the expanding force will exert its influence after the original hernial route has been barred.

The direction of the approach to the problem of hernial repair has for some time impressed me as not being in accordance with the mechanical disposition of the physical forces involved. Reliance is now placed upon what is really only an estimate of the strength of the reconstructed abdominal wall for which there are no indicators except experience. This estimate is based upon the erroneous assumption that if the wall is firm to external pressure it will not yield to the thrust from within. It would seem to be more logical to attempt to find the weakness in the abdominal wall against a force applied in the direction that will reveal where its impact is greater than the restraining power. This is the expanding

pressure inside the abdomen and the approach should be from that direction.

These aims are accomplished by using the exploring finger inside the abdomen to duplicate the contents of the hernia before it is repaired; and after the repair, having the finger imitate the intra-abdominal pressure at the vulnerable points to discover any routes of recurrence and if the repair is firm. Then if inadequacies are discovered, they can be corrected before the operation is concluded. Harkins et al.[3] expressed surprise at how few surgeons will place the index finger through the open sac into the abdomen to explore the femoral ring and Hesselbach's triangle. Although they regard this maneuver as an essential feature of all herniotomy repairs, it is obvious that it cannot reveal the intrinsic soundness of the inguinal wall since the canal must be disrupted to reach that opening; nor can the strength of the repair be tested after this avenue is closed.

The leading advocate of the intra-abdominal approach to herniorrhaphy was LaRoque[5–8] who successfully used it in over 1,500 cases. It had on occasion been employed in instances of strangulation. Although there have been a few more proponents, its disadvantages were considered generally to be greater than its advantages.[4] One of the former, according to Bevan,[2] was the performance of an unnecessary laparotomy. LaRoque's primary objective was the disposal of the sac and redundant peritoneum with as little injury as possible to the muscular and fascial constituents of the inguinal area. In his method the sac was dissected and its neck closed first; if any repair was thought to be necessary, it was undertaken afterward. The essential difference between his procedure and the one I am proposing is that he failed to seize the opportunity with the peritoneum open, of testing the abdominal wall to find where the weakness, if any, may be; nor did he use this chance to discover if his repair was firm and adequate before the peritoneum was closed. It is my belief that if a suitable means is at hand for making this test it should be given preference over the skill and judgment of anyone, regardless of how great these might be. There are other important differences: One is that the arch of the external ring is not divided and another, the sac is not only not dissected nor removed but deliberately retained for the security of the inguinal wall.

It may be well to state that LaRoque[9] condemned the peritoneal closure I am recommending but did not explain his antipathy towards it. Even if one does not follow this method of herniorrhaphy there are still the many other advantages of the transperitoneal approach that give the operator full control over any surgical opportunities or situations he may come upon.

The advantages of this approach stated by LaRoque and later amplified by Williams[11] are: (1) The sac can be easily emptied and removed, and its opening accurately closed. (2) Strangulated viscera can be examined after its return to the abdomen. (3) Intra-abdominal extensions of pathological conditions in the hernia can be discovered, i.e., contents which have been reduced during attempts before operation but were not visible. (4) Other intra-abdominal operations can be undertaken at the same time such as removal of the appendix or procedures on the female generative organs.* (5) Sliding hernias can be more easily repaired. (6) Repair of congenital hernias, which is difficult at times because of the thinness of the sac, is facilitated. (7) Undescended testicles can more readily be put into proper position. (8) All the structures on both sides

* A hernia often can be repaired intra-abdominally during an operation performed primarily for other conditions. Once when removing an acutely inflamed appendix from a six-year old boy who also had a right inguinal hernia, the latter was cured by merely suturing the upper leaf of peritoneum to the lower border of the internal ring. There was no additional hazard since it amounted to nothing more than the required peritoneal closure. Similarly when working in the pelvis through a midline incision, the internal ring and the whole inguinal mechanism is accessible. I have taken advantage of that fact several times.

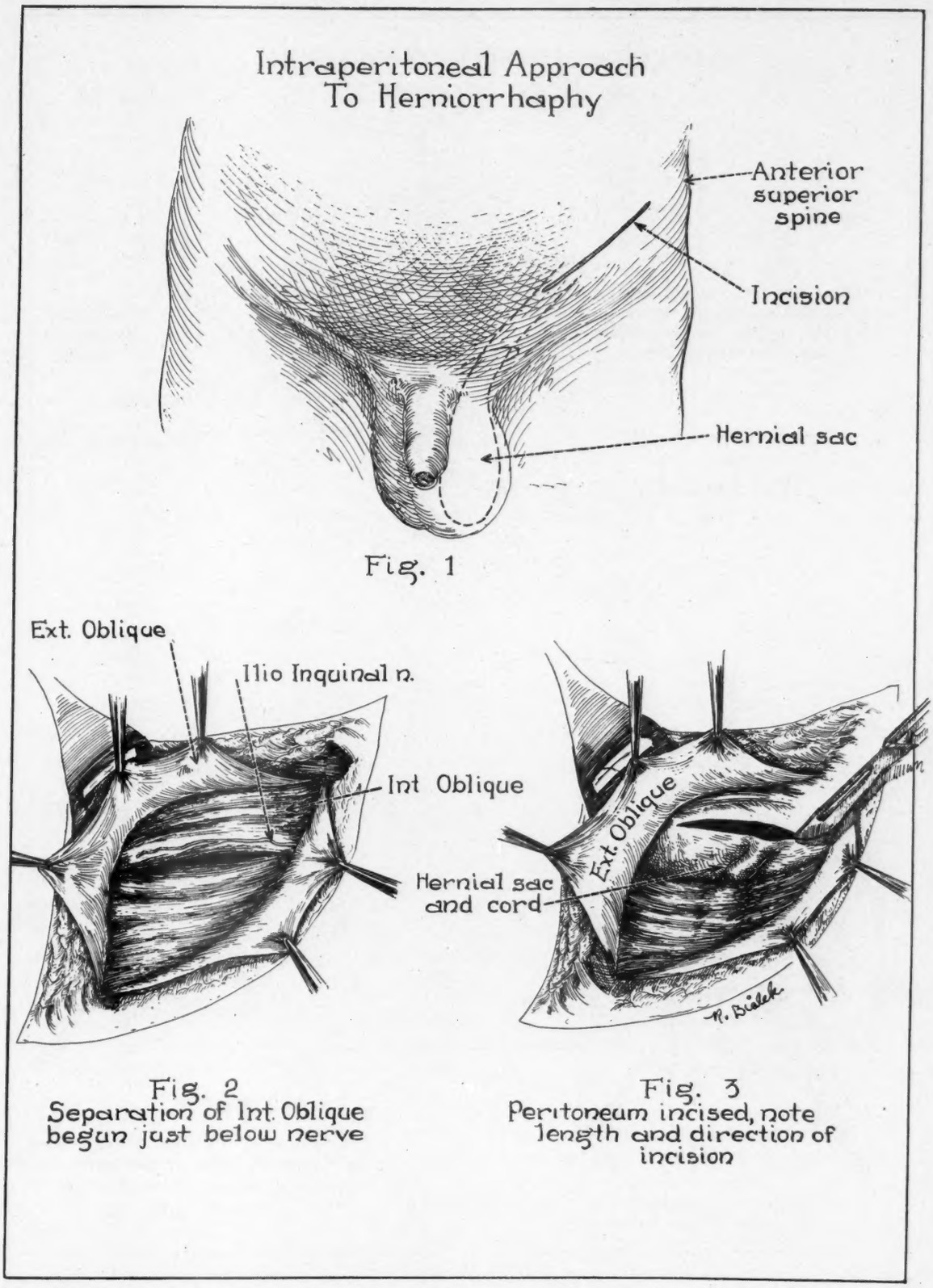

FIG. 1. The incision need not be very long at first. If reconstruction is necessary, it can be lengthened to uncover the external ring. The external oblique is opened medial to the ring leaving the latter intact.

FIG. 2. Muscle separation is done below the ilio-inguinal nerve if that runs transversely or else just a little above where the muscle fibers begin to assume a fibrous character. It is not necessary to reach the peritoneum exactly at the internal aperture of the hernia.

FIG. 3. The peritoneum is opened transversely and clamps put on the angles for guides. Clamps are placed on the upper peritoneal edge, too, and left there, so it can be readily found when its closure is started.

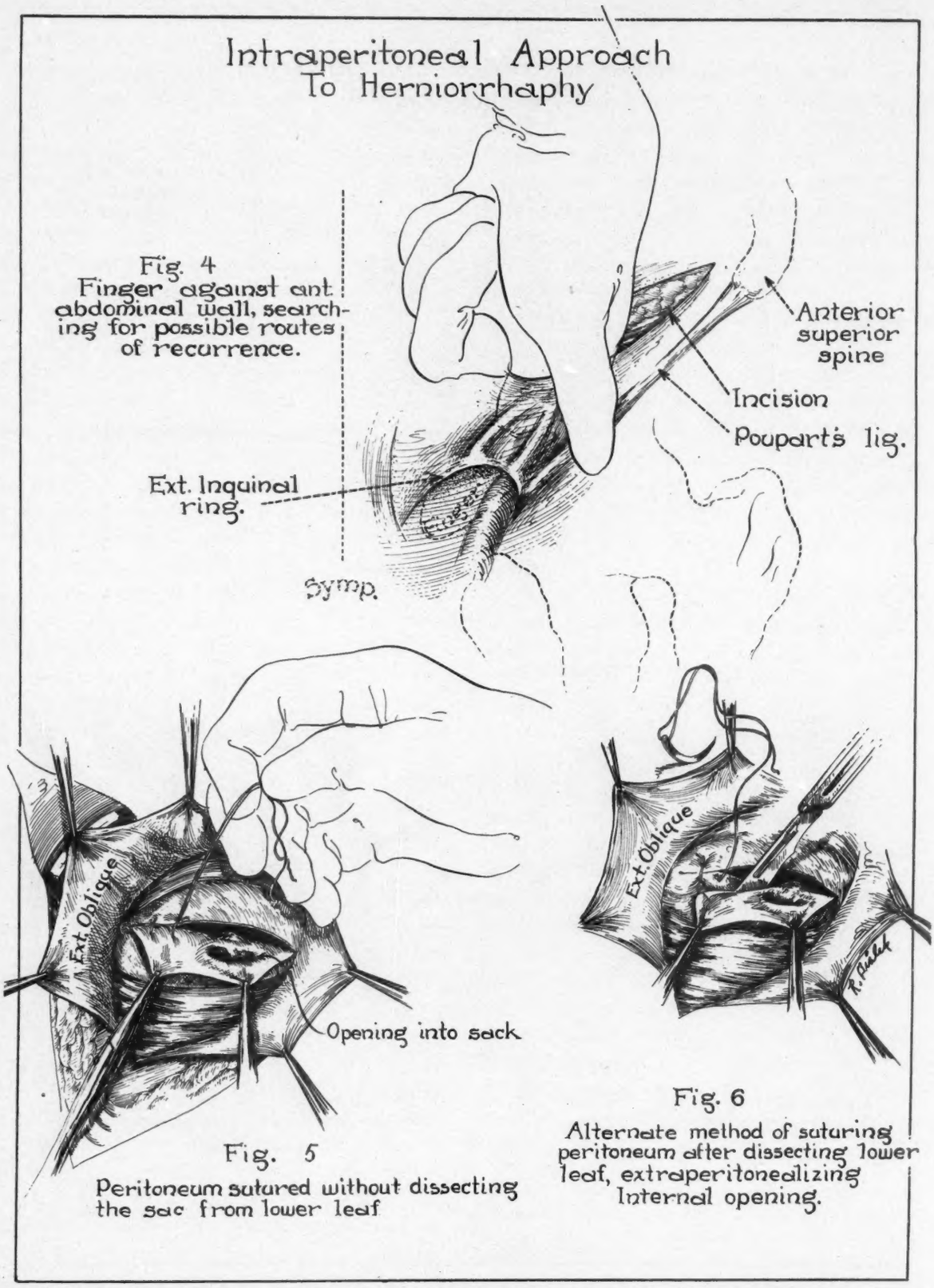

FIG. 4. After the finger has been in the sac to duplicate the hernia, it is removed and placed in the peritoneal cavity behind the sac to test the strength of the inguinal wall and search for all possible sources of failure.

FIG. 5. The closure is not started until all reconstruction has been finished and its stability proved by the maneuver illustrated in Figure 4. If reconstruction is required, the incision is lengthened to uncover the external ring allowing the fascia of the external oblique to be separated far enough to permit any necessary suturing.

[FIG. 6. The alternate method of closing is seldom used.

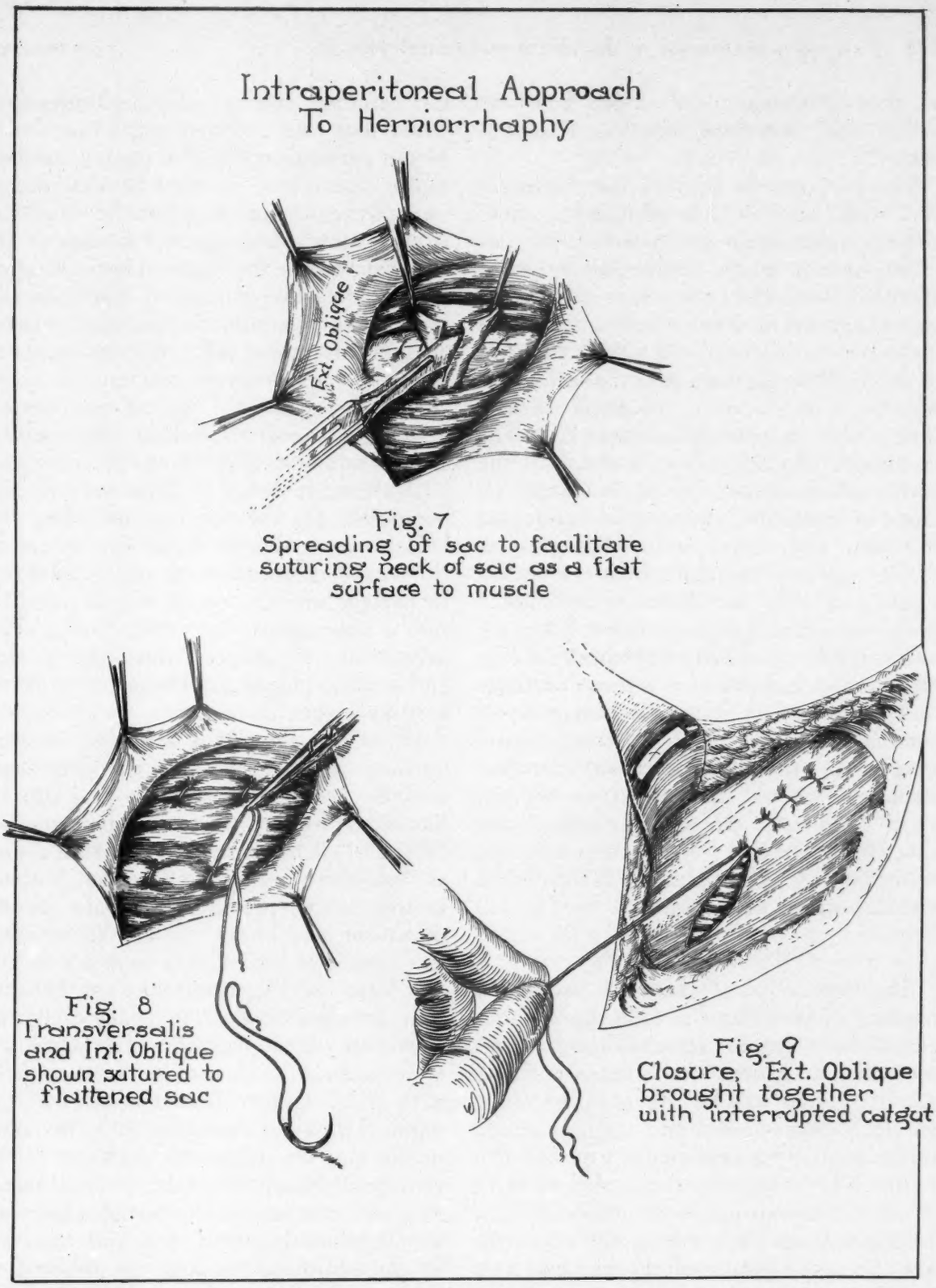
Intraperitoneal Approach
To Herniorrhaphy
Ext. Oblique
Fig. 7
Spreading of sac to facilitate suturing neck of sac as a flat surface to muscle
Fig. 8
Transversalis and Int. Oblique shown sutured to flattened sac
Fig. 9
Closure, Ext. Oblique brought together with interrupted catgut

FIG. 7. The neck of the sac is opened to form a flat surface of peritoneum. The incision into it under the muscles can be continued with scissors as far as can be conveniently reached. There is no danger of injuring the cord or its vessels since these are beneath the posterior surface of the sac. The distal part of the sac can be disregarded. However, the neck may be opened beyond the external ring exposing its peritoneum. This may be sutured to the surrounding tissues with impunity to become a strong supporting structure, since its endothelial surface quickly disappears and is replaced by adhesions.

FIG. 8. The sutures uniting the transverse muscles pass through the peritoneal surface beneath it, thus bringing the cord forward and fixing the peritoneal closure. The distal sutures are used only when the sac is very large. If the neck of the sac is of sufficient width to spread from the inguinal ligament to the conjoined tendon at the pubis, it can be held in that position by fine sutures to these structures. Its elasticity will be cast off along with the other peritoneal characteristics and thus, by conversion into fibrous tissue, contribute additional strength to the inguinal wall.

FIG. 9. Closure; the external oblique is brought together with interrupted catgut.

of the peritoneum are under constant vision and, therefore, are less liable to injury.

The purposes for which I use the intra-abdominal approach, in addition to those already mentioned are directed just as much, if not more, at the diagnosis of what will be necessary to create an effective barrier against recurrence and to determine if the barrier has been erected, as they are to the facilities for managing the sac. These are: (1) The discovery of small hernias that, although causing discomfort, cannot be located clinically; (2) the study of the hernia which demonstrates accurately its mode of formation; (3) complete exclusion from the abdominal cavity, not closure, of the aperture through which the hernia passed; (4) the likelihood of redundant peritoneum and accessory sacs of initiating a recurrence; (5) the effect of the expanding intra-abdominal pressure before and especially after the hernia is repaired to demonstrate if the repair is firm and adequate. (6) the determination of what structures should be united or indeed, as is frequently the case, whether any should be joined; (7) the necessity for transplanting the cord; and (8) the type and disposition of the sutures.

PLAN OF OPERATION

The term "plan" is used because a method of procedure is followed without consistently employing any specific herniorrhaphy. More often than not, no reconstruction will be required. As much surgical discernment and understanding of the anatomy and physiology as well as a meticulous technic are demanded to carry it out, as has always been necessary. The predominating ideas during the operation are the investigation of the inguinal area to discover, after the hernia sac is emptied, if that part of the abdominal wall is able to retain successfully the intra-abdominal pressure, and if not, where and how to reconstruct it so it can.

An incision is made over the inguinal canal starting about one inch below the anterior superior spine and extending down over the external ring. The fascia of the external oblique is incised parallel to its fibers just internal to the medial limb of the external ring but the ring itself is not opened. The transverse muscles are exposed and the ilio-inguinal nerve sought. This nerve follows one of two courses: It either runs parallel to the fibers of these muscles or may take a proximodistal course. In either event the muscle fibers should be separated so as to prevent injury; in the first instance the opening should be made right below the nerve and in the latter it should be dissected so it can be moved toward the midline when the muscle separation is done. The fibers of the transverse muscles are separated down to the peritoneum which will be reached just a little above the internal ring. The peritoneum is opened transversely, too, and clamps placed at the angles to serve as guides when closing.

By lifting the distal leaf, the internal opening of the hernia can easily be seen and the lower border of this ring can be identified by its thickened peritoneum. Of course, if intestines or omentum are in the sac there is no difficulty; but if there is any doubt, the finger may be passed down the sac as an aid for recognizing this opening. I no longer look for it but just pass the finger into the sac because that is what follows in order that the hernia may be duplicated while the patient is recumbent. This border is then held with Allis clamps. The structures of the inguinal area are examined with the finger in the sac. The edge and thickness of the conjoined tendon, the width of the external ring with relation to the distance between the inguinal ligament and the insertion of the conjoined tendon, the position of the cord and the general solidity of the area can be made out. The finger is removed, then passed behind the sac and pressed against the parietal peritoneum of the inguinal area to determine its stability after the abdominal viscera no longer can have access to the original

hernial opening. The finger starts at the insertion of the rectus into the pubis and slowly and carefully passes laterally to the pubic tubercle, the superior pubic ligament, lacunar and inguinal ligaments, the spermatic fascia, and the area behind the cord including the femoral ring, all the time exerting pressure and probing for a weak place. If none is found, it may be assumed that the inguinal region is adequate and no reconstruction will be necessary.

The lower border of the internal ring is then used as the lower leaf of peritoneum to which the upper leaf is sutured for closing the abdomen. For this figure-of-eight suture No. 00 catgut is used. The opening of the sac with its neck is thus settled completely outside the peritoneal cavity leaving not a vestige inside. To anchor it there it is opened ventrally down to the external ring making a flat surface of peritoneum out of the cylindrical neck and placing it immediately beneath the transverse muscles. This flat surface is caught in the interrupted sutures uniting these muscles. The external oblique and skin are closed. As the illustrations depict the operation for a simple indirect hernia thus becomes little more than the opening and closing of a low McBurney incision and the convalescence may be treated as such. There is no danger of tissues pulling apart since the only important suturing has been done in peritoneum and that adheres quickly.

When a weak place is found measures must be taken to strengthen it. In indirect hernias a space frequently is present between the conjoined tendon and the suprapubic ligament which may require one or more tantalum or steel sutures placed behind the cord to obstruct it. A strip of fascia from the external oblique may be used if that is preferred. Special attention should be given to this location; and if there is any doubt, its closure surely will do no harm. At other times the lacunar ligament in addition to the suprapubic must be used, but there has been no occasion when I deemed it necessary to employ the inguinal ligament. What structures need to be joined are quickly revealed since with one finger in the peritoneal cavity behind the inguinal wall and another in front of it, the situation between them is sharply outlined; borders of tendons, ligaments and muscles become clearly delineated. The fingers serve also as ready guides for the suturing needle. When the suturing is finished its stability can then be tested by the finger inside the abdomen pressing against it. If it is sound and redundant peritoneum is unable to probe into it, the abdomen can be closed as before. The convalescence may be lengthened to some extent but need not be unnecessarily prolonged.

It will be found as a general although not an invariable rule that the weakness of the abdominal wall will be in direct relation to the distance between the internal and external rings, the latter being fixed. If the distance is short, the internal aperture is low and large, and the space between the inguinal ligament and the rectus muscle wide. Reconstruction more than likely will be required. When the distance is long, encompassing the whole inguinal canal, the hernia passes down the canal but does not exert pressure in the dorsoventral direction. The structural positions are such, that not having been subjected to prolonged stress and distortion, they can fully withstand the pressure from that direction and little or no reconstruction will be necessary. That is why children rarely require more than high ligation of the sac to cure a hernia. My experience with adults has been that size is no criterion of what has to be done and nearly half the hernias need no reconstruction whatever.

If the hernia is direct the exploring finger in the sac will be found pushing a pad of fat around the edge of the conjoined tendon which acts as a wedge between the conjoined tendon and the inguinal ligament. The tendon is shoved medially when this pad inserts itself between it and the taut

shelf of the ligament. A finger should be placed on the pad externally so as to invert the sac into the peritoneal cavity, through which the peritoneum of the most dependent part is caught with Allis clamps, pulling the sac into the peritoneal opening and the pad of fat up under the transverse muscles.

The finger in the abdomen will find an area to obstruct which occasionally is so large that some may consider it necessary to transplant the cord. The arch of the external ring can then be opened and the cord lifted out; the structures to be united are decided upon and the suturing done. In this situation it will be pleasing to note that, with the sac and fat pad completely out of the way without any dissection, the facility for maneuver is at once increased.

The firmness of the reconstructed wall may then be examined by the finger inside the abdomen. If it is found to be sufficient, the inverted peritoneum of the sac is used for the lower leaf, as in an indirect hernia. Its disposition is not the same and I have found it expedient to pass sutures through its apex and the original edge of the lower leaf when joining it to the upper leaf. The result is the affixing of the peritoneum of the inverted sac to the peritoneum of the abdominal closure, completely disposing of it. The pad of fat is well out of the way under the transverse muscles and may be disregarded.

However, when considered from the intra-abdominal perspective, there is little need during the repair to distinguish a direct from an indirect hernia. The cure for both depends upon the successful obstruction of a triangle which has for its base the suprapubic ligament and medial end of the iliopubic tract and whose sides are the inguinal ligament laterally and conjoined tendon medially. Even with the external oblique divided internal to the external ring, this area can be clearly exposed when the lateral leaf of the fascia is rotated outward. In a direct hernia this triangle may be relatively larger and require relaxation incisions into the rectus sheath to reduce tension, yet its surgical management can be practically the same as for an indirect hernia.

In either case, the cord may be dissected from its bed and retracted laterally exposing the weak transversalis layer beneath it. A strip of fascia taken from the medial leaf of the opened external oblique is left attached at its pubic insertion and used as a running suture between the conjoined tendon and the suprapubic and lacunar ligaments. Two or three loops of this suture, placed so as to obliterate the angle between the conjoined tendon and the pubis and catching the underlying transversalis fascia in its sweep, will make a firm bulwark which the exploring finger inside the abdomen cannot penetrate. The cord is forced upward to emerge from the apex of the triangle and when allowed to fall back upon the suture line, will not be affected by the closure of the external oblique as that will be medial to it.

Discussion of all the variables encountered in herniorrhaphies would unduly prolong this article. Strangulated, incarcerated, and recurrent, as well as reducible direct and indirect hernias have been done in this manner. I want to mention a type that has been somewhat intriguing: small hernias that are obscure clinically but produce intense discomfort. In one such case, the patient, a woman of fifty, had worn a double truss for years because of the comfort it afforded. She had repeatedly been refused operation because the hernia could not be seen or felt and she was thought to be neurotically magnifying her moderate abdominal ptosis. At operation the internal openings of the sacs hardly admitted the tip of the finger. Being barely an inch long it is not surprising they were not found upon physical examination. Their apertures were thickened and smaller in diameter than the sac and it could easily be seen that incarceration of bits of intestine or omentum was taking place. Relief was obtained by merely suturing these rings. The point germane to this discussion is that these hernias could not have been found nor

their characteristics revealed in any other way than by the intra-abdominal approach.

Lest the impression arise that this method is cumbersome and complicated, it may be said that it will be amazing, when once understood, how simply and fluently with a great saving of time, this plan for achieving the cure of a hernia goes forward and with what accuracy and certainty of result, barring surgical hazards, the inconstancies of the inguinal area can be rectified by any measures that are familiar to the operator. Two examples may be cited: In one the type of hernia could not be made out clinically and at operation an oval space about 3 by 1 cm. revealed at once through the abdomen, was found in the transversalis fascia just behind the upper part of the conjoined tendon Through it passed a large pad of fat but without a definite peritoneal sac. The cord was retracted medially, and with the finger in the abdominal side of the opening acting as a guide, the fat was excised and a running suture of fine wire on the exposed aspect was used to draw the edges together. Pressure upon it from within the abdomen disclosed that it was well able to support the intra-abdominal expansion. The patient has been clinically well for three years. The other was a large incarcerated indirect hernia. When the abdomen was opened, the omentum in the sac could not be retracted into the abdomen. A curved clamp with point upward was passed down the neck of the sac until it could be seen a little beyond the external ring where the sac was opened over it. A large mass of omentum was then resected at the level of the external ring and removed from the scrotum, whereupon that in the neck was easily withdrawn into the abdomen. This omentum could just as well have been resected at the internal ring. Ordinarily, some reconstruction would have followed but the finger in the abdomen demonstrated conclusively that with the sac empty the inguinal area was amply protected. Therefore, only the internal opening of the sac was excluded from the abdomen and subsequent events have borne out the correctness of judgment. In this case an extensive herniorrhaphy would have been done if custom had been followed, since without the abdominal opening there was no way to show the strength of the abdominal wall. In addition a statistical cure for this herniorrhaphy would have been obtained in a case that did not need it.

This plan is particularly applicable in the aged and on any other occasion when the use of infiltration anesthesia is indicated. The sac is not dissected and there is less actual manipulation. For these reasons the duration of the operation is shorter. Furthermore such tension as must necessarily be exerted upon the peritoneum, omentum or intestines is toward and not away from the root of the mesentery and thus produces little if any discomfort.

COMMENT

The experience of investigating hernias from within the abdomen has suggested some changes in the herniorrhaphy procedure which require explanation. It will be observed that the sac, including the internal aperture of the hernia, is intentionally preserved, little attention is paid to redundant peritoneum and accessory sacs, and the arch of the external ring is maintained intact until its division is thought to be necessary.

Numerous studies of the anatomy of the inguinal region have been made to help solve the problems of inguinal herniorrhaphy. Of these one of the clearest and most detailed is that of McVay and Anson.[10] Concerning the inguinal ligament, they regard its use as illogical since it is not fixed and can be pulled up by rotation of the pelvis to leave the lower inguinal area completely unprotected. They conclude that it ought to be ignored and instead the suprapubic ligament (Cooper's ligament) should be united with the conjoined tendon.

Their findings can be confirmed by exploring the inguinal area through the transperitoneal route. This should be done with the external ring intact as its division will permit lateral rotation and deviation of the inguinal ligament with a concomitant increase in the distance between the lateral border of the rectus sheath and this ligament. When the ring, regardless of its size, is opened, a false impression of weakness is created and the relationship and mobility of the structures are changed. Since this arch is one of the strong stabilizing influences of the inguinal area, I seldom divide it.

The opinion that the sac of an inguinal hernia is not always a liability and may indeed be an asset contradicts, of course, a surgical dictum that is considered almost axiomatic. The fate of peritoneum left outside the abdominal cavity in large incisional and ventral hernias never has given me any cause for concern. On numerous occasions I have left the sac of an inguinal hernia intact and now do it in every case. Some of these were quite large and so far there has been no reason for regret. The prophets of gloom who expected it would become either a hydrocele or an avenue of recurrence have had no confirmation of their dire predictions. Bånerjee[1] left the sac without even opening the end at the internal ring in over sixty cases and in both his experience and mine, although I do open this upper end, there has been no trouble. It may be that the endothelium loses its function and characteristics when not connected with the peritoneal cavity and the sac is obliterated by adhesions or the same mechanism that closes the funicular process in the fetus. From whatever cause, it quickly disappears and only a trace can be found a few days after operation although undoubtedly its components and attachments incorporated into the surrounding structures must still be present.

In addition to being unnecessary, it may even be detrimental to remove the sac. Regardless of the manner of dissection there must be some tearing of the fascias of the cord along with stretching and attenuation of muscle fibers that may permanently impair their ability to contract again, thus enlarging and weakening the whole inguinal region. I doubt, as some contend, that the fibrosis following this dissection more than compensates for the injury done. Moreover a structure is removed that, simply because of its presence, can be useful in the defense of the hernia. This will be better understood when considered in connection with the treatment of the neck of the sac.

In the procedures described, I stated that the internal aperture is excluded from the peritoneal cavity and not merely closed. These are not the same. When inside the peritoneal cavity, if the peritoneum around the opening is dissected, it will require a closure in addition to that of the peritoneal incision. The sac and cord become free and mobile allowing them to fall down the inguinal canal for a short distance. But if the upper leaf of peritoneum is joined to the peritoneum just below the internal opening to close the cavity, elimination of the sac from the peritoneal cavity is assured and only one line of sutures is required. The sac and cord do not descend and remain for the protection of the hernia. When the neck is opened a surface of peritoneum is brought directly into contact with the flat undersurface of the transverse muscles to which it adheres, carrying the cord forward with it. This wide attachment further limits mobility and strengthens the union of the muscles, fascias and cord, thus consolidating the whole inguinal resistance.

There is a difference, too, in the deployment of the peritoneum. Since the original hernial pathway has been completely excluded, an entirely new situation comes into existence. The intra-abdominal expansion is aimed, not down a canal but against the abdominal wall. Here the internal pressure will have to oppose it, the layers of peritoneum comprising the sac surrounded by its unharmed fascial and

muscular coats, in addition to the tissues already in existence. The pressure upon these is sustained, not by the inside elastic peritoneum but by the fibrous tissue of the diffuse external connections of the sac to the cremaster muscle and fascia, the internal oblique, and the transversalis and spermatic fascias. The sac and cord are left as a unit and continue to function as such. Non-interference in this area not only leaves the inguinal mechanism, which may be fully adequate, completely intact, but also does not destroy such capacity as it may already have, thus making rebuilding when required much more satisfactory. The intra-abdominal expansion can affect the inguinal wall in a manner that can be correctly predicted only when the latter is left undisturbed. It may be inherently competent to restrain this power as will be found so often when explored from within.

I believe that the importance of secondary sacs has been exaggerated. It is not unusual to find much redundant peritoneum in this area, so much sometimes that it may be assumed to be another sac. Suturing the neck of the sac in the manner I have described will eliminate much of this redundancy if that is considered helpful. However, if the accessory sac or redundant peritoneum cannot insinuate itself between any of the structures of the inguinal area, it will not be a source of recurrence. To reason that it will is to admit that the original hernia prevented the formation of a secondary hernia by this sac. Occasionally, secondary hernias are found but not nearly as often as accessory sacs.

It is not difficult to decide if a secondary sac or redundant peritoneum can initiate a recurrence. When the finger is placed in it after the herniorrhaphy is done and does not find any escape, it can be disregarded. But if an exit is found it must be closed. Removal of this sac does not reduce the elasticity and distensibility of the peritoneum. If an outlet is present, the peritoneum will find it. Hence it is necessary to interrupt the connection between the abdominal cavity and any potential hernial space. Hernias seldom recur because the sac has not been ligated high enough or excess peritoneum insufficiently removed. Failures may be due to the total inability of the structures to retain the intra-abdominal pressure but more often they originate from cleavages in the musculofascial layers through which peritoneum at first slowly slips and then gradually separates. It is the persistence of the intra-abdominal expansion against a vulnerable point which eventually produces the recurrence.

CONCLUSIONS

1. The intra-abdominal approach to inguinal herniorrhaphy is anatomically and mechanically correct and therefore superior to the extra-abdominal approach, now universally used.

2. Through it, every factor on both sides of the peritoneum including pressure phenomena, can be properly evaluated.

3. The large number of hernias which do not require any reconstruction for their cure can be accurately selected.

4. When reconstruction is necessary it provides a means for determining with precision what needs to be done, adequate opportunity for doing it and a way to demonstrate if the desired result has been accomplished before the patient leaves the table.

5. The sac and cord, with the fibrous attachments to its surrounding structures, when left acting as a unit, are useful for the protection of the inguinal region.

6. The sac, if allowed to remain, does not become a hydrocele or an avenue of recurrence.

7. As a result of investigating hernias from within the abdomen, the following changes in the herniorrhaphy procedure, are suggested: (1) The internal opening should be excluded from the abdominal cavity, not merely closed. (2) The external ring should not be opened until the necessity for it has been shown. (3) Dissection

of the sac should not be done as the unity of the structures defending the area is thereby adversely affected. (4) The upper part of the sac should not be discarded. Instead it can be transformed from a cylinder to a flat surface to be caught in the sutures closing the transverse muscles, thus converting it into a strong integrating and supporting agent.

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The two most important structures that may be injured in femoral hernia repair are the femoral vein and the bladder. If the hernia is strangulated, an intestinal loop may be injured. These dangers may be avoided by carefully dissecting away all fat and areolar tissue about the sac before an attempt is made to ligate the neck of the sac or place the closing sutures. A few minutes spent in clearing the field and indentifying anatomical structures will aid in the prevention of operative errors.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

A DEVICE TO SIMPLIFY END-TO-END ANASTOMOSIS OF THE LARGE BOWEL*

THE ELIMINATION OF UNEQUAL DIAMETERS OF THE TWO SEGMENTS TO BE ANASTOMOSED

NATHANIEL B. STANTON, M.D.
Senior Attending Surgeon, Muhlenberg Hospital
PLAINFIELD, NEW JERSEY

ONE of the most troublesome problems, after resection of new growths in the large bowel, is to secure an equal diameter of the proximal and distal ends to be anastomosed. As a rule this is because the bowel proximal to the tumor is dilated and that distal to the tumor the bowel is collapsed or contracted.

The unequal diameters of the two ends to be anastomosed can easily be overcome by the simple technic of dilating the bowel by means of air injected through the rectum. A Weber insufflator such as that used in barium contrast enemas is employed. The air is injected after the abdomen is opened so that the amount of dilatation can be directly observed. The air flows easily up through the sigmoid, descending splenic flexure and into the transverse colon.

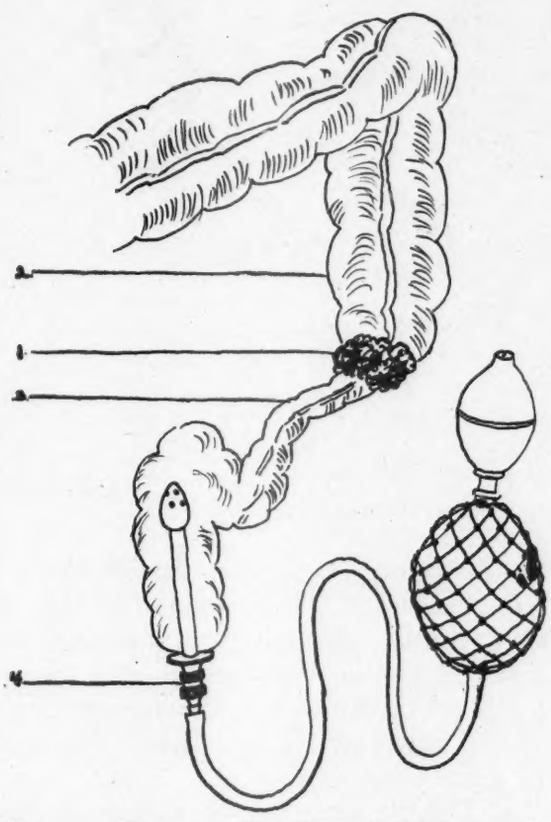

FIG. 1. 1, Tumor; 2, dilated proximal loop; 3, contracted distal loop; 4, Weber insufflator.

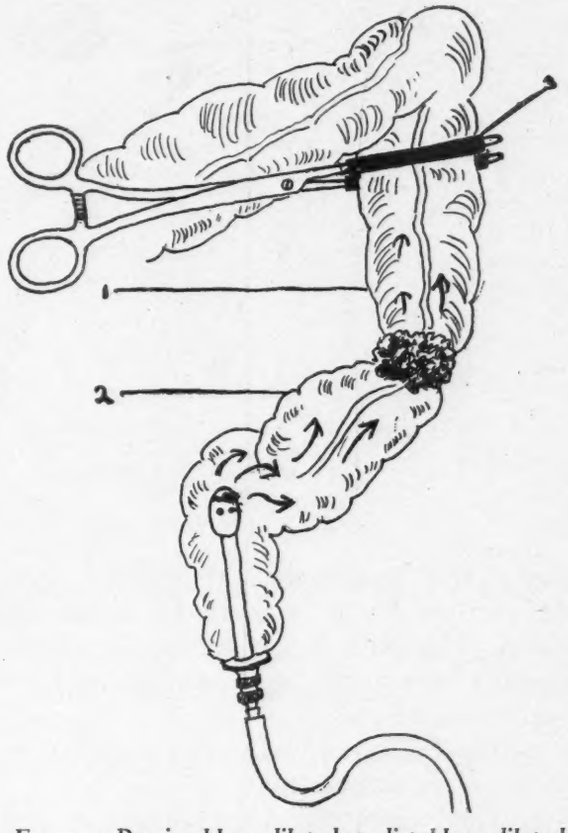

FIG. 2. 1, Proximal loop dilated; 2, distal loop dilated; 3, clamp to limit air to operative area.

The following procedure is followed and it is applicable for tumors of the transverse colon, the splenic flexure, the descending and sigmoid colon:

* Read before the Society of Surgeons of New Jersey, January 30, 1946.

1. All patients are given a preoperative course of succynl-sulfathiazole therapy.

2. As soon as the patient is under anesthesia the insufflator is inserted into the rectum for a distance of about six inches. The bulb is left under the sterile drapes where it can be reached easily by a floating nurse.

3. The tumor and adjoining bowel to be resected are mapped out.

4. The mesenteric attachments of this segment are divided. All lymph nodes are removed; all vessels are ligated.

5. A rubber covered clamp is placed across the bowel about five inches above the proximal area to be anastomosed. This clamp prevents the air from going back into portions of the colon not involved in the operation.

6. Air is then pumped into the bowel by the floating nurse. This is done under direct vision and it is surprising how little air is necessary to dilate the bowel. Only three or four squeezes of the bulb are necessary to increase the diameter of the bowel considerably. The bowel distal to the tumor sometimes dilates three to four times its former diameter. The air also passes through the segment surrounded by the tumor and dilates the area proximal to the tumor. Usually the lumen of the bowel above and below the tumor area are about equal.

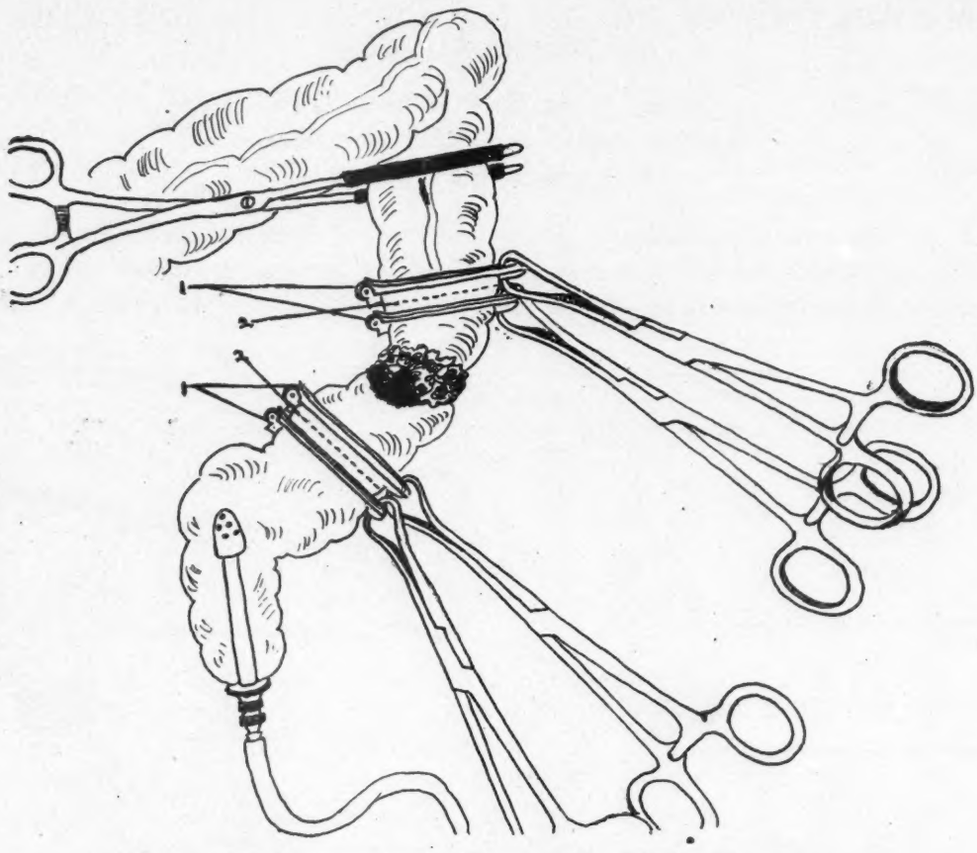

Fig. 3. 1, Double anastomotic clamps; 2, line of division by cautery.

7. Double anastomotic clamps are then placed above and below the tumor at the sites previously determined upon. By placing the anastomotic clamps on both the proximal and distal ends, while the bowel is dilated with air, makes it possible to secure an equal diameter of both ends. Both proximal and distal loops are then divided with the cautery. The tumor with its adjoining bowel is then removed.

8. The anastomotic clamps on the proximal and distal segments of the bowel are then approximated and the anastomosis

can be started. Rubber covered clamps are placed across the bowel on each side of the anastomotic clamps to prevent any spill. These are removed as soon as the suture of

9. The mesocolon is then repaired. Ten Gm. of sulfanilimide are introduced into the abdomen. The wound is closed without drainage; no retention sutures are used.

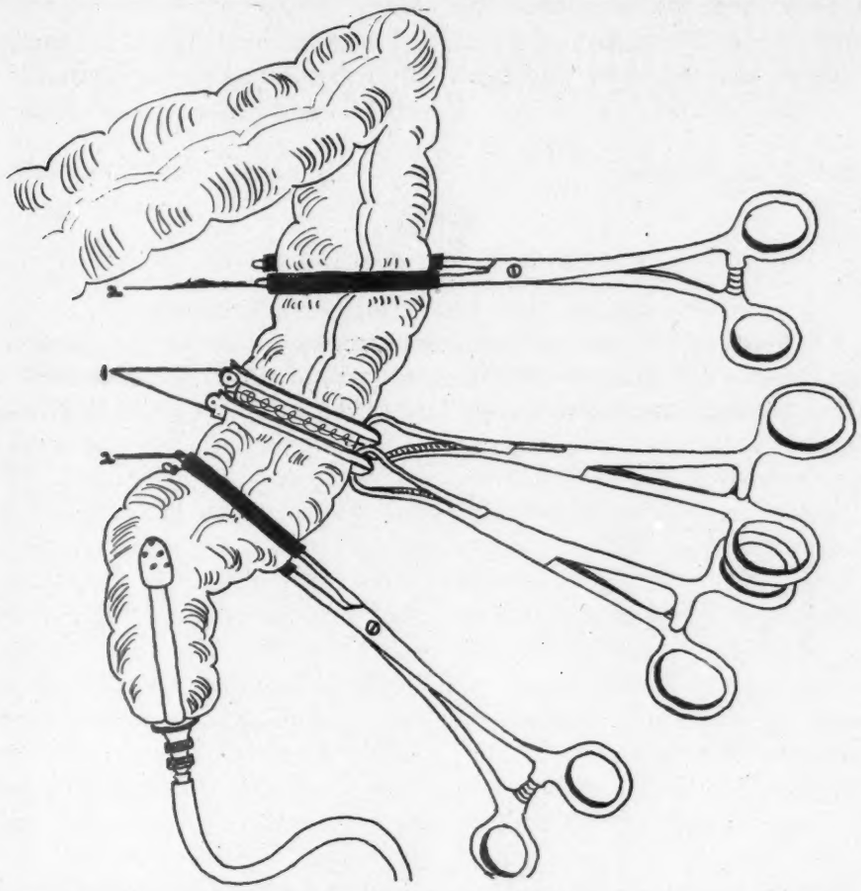

Fig. 4. 1, Proximal and distal clamps approximated, posterior suture; 2, rubber clamps to prevent spill.

the entire mucous membrane is completed. A posterior suture of silk or chromic dulox which includes both peritoneum and muscular coats is first introduced. This can be either continuous or interrupted. When completed, this posterior suture secures the desired diameter of the anastomosis. Even when the anastomotic clamps are removed and the air released the diameter does not shrink. The diameter is kept fixed by the posterior suture.

Any desired method of suturing can be used to complete the anastomosis. In our hospital we usually use three complete circles of sutures, each one outside and independent of the other two. The original posterior suture layer is continued on as the final anterior layer.

Postoperative Treatment. Nothing is given by mouth until gas is expelled, which is usually two to three days postoperatively. The patient is given 2,500 to 3,000 cc. of intravenous fluids daily; these include amino acids. One ampul of prostigmin is administered every four hours, and vitamins B and C are injected intramuscularly. Rectal irrigations, about three to five ounces, are given frequently, and intravenous sulfa medication and transfusions are also given if necessary.

SUMMARY

This method of securing adequate and equal diameters of the two bowel ends in end-to-end anastomosis has been used in a number of cases. It has been used in

carcinomas of the transverse colon, the splenic flexure, the descending and sigmoid colon. It can be used in any case in which there is room enough to place anastomotic clamps. We have had no accidents, no peritonitis, and no deaths in any of these patients on whom this method has been used.

We are usually able to obtain flatus on the second or third postoperative day. Occasionally, patients have had a bowel movement on the second postoperative day.

It is believed that this method of bowel dilatation can be a valuable adjunct in end-to-end anastomosis of the large bowel.

ENTEROCOLITIS is an inflammatory process involving the small and large bowel. Colitis is an inflammatory state of the large bowel alone.

From "Ambulatory Proctology" by Alfred J. Cantor (Paul B. Hoeber, Inc.).

Case Reports

TOTAL GASTRECTOMY FOR COMPLETE CARCINOMATOUS INVOLVEMEMT OF THE STOMACH

Col. Meredith G. Beaver, Maj. Sam Gendel

AND

Maj. E. M. Papper

MEDICAL CORPS, ARMY OF THE UNITED STATES

TOTAL gastrectomy has been performed infrequently because of technical difficulties and the high operative mortality. In contrast, a great deal of experience with subtotal gastrectomy has been accumulated and is reflected in a decreasing mortality rate. The purpose of this paper is to report a case of scirrhous carcinoma of the stomach of the linitis plastica type, for which a total gastrectomy was successfully performed. In planning the type of operation required, it was thought that subtotal gastrectomy would be the one of choice. The finding at the time of surgery of a "leather bottle" type of stomach, necessitated total gastrectomy instead. This emphasizes the fact that total gastrectomy for carcinoma of the stomach cannot always be anticipated prior to surgery.

The necessity for careful preoperative preparation with special reference to combating anemia, protein deficiency, and the maintenance of a proper fluid balance is obvious. Scrupulous operative technic is essential and the adequate postoperative care of these patients is of the utmost importance.

A study of the literature on total gastrectomy indicates that there is considerable variance in operative technic. Willy Meyer[10] has described intrathoracic esophagojejunostomy employing combined abdominal and thoracic exploration for those cases in which the esophagus is involved and in which its adequate mobilization through the abdomen is impossible. Some authors believe that removal of the spleen is contraindicated. Others suggest that its removal does not materially add to the operative risk nor complicate the postoperative picture. This latter group states that if splenectomy improves the exposure and the ease with which the esophagus can be mobilized, it should be done without hesitation. The incision generally advocated is the high left paramedian or subcostal type. Little emphasis is placed on the incision except that all agree that it should be high.

There is a variance of opinion as to the use of jejunojejunostomy and also as to the necessity for draining the duodenal loop. Horsley[7] anastomoses the stump of the duodenum into the right half of the jejunal loop, thus providing drainage for the duodenum and preventing volvulus of the jejunum. Some authors believe that the use of the Levine tube is important and obviates the necessity for an enteroenterostomy or a jejunostomy tube. However, Lynch and Priestly,[8] Waugh and Neel,[15] Waltman Walters,[13] Chute and Albright[2] state that a jejunostomy tube is important for the protection of the anastomosis and also for early postoperative feeding. Willy Meyer[10] prefers the jejunostomy tube to an indwelling Levine tube passed through the anastomosis. Ducan[5] passes the Levine tube prior to the opera-

tion, then threads it into the distal loop of the jejunum after the anastomosis is completed.

It is interesting to note that there is considerable difference of opinion and a wide variation in the type of anesthesia recommended for total gastrectomy. Spinal anesthesia employing the continuous technic or Lemmon, or on occasion, the single dose technic, is advocated by Marshall and Zintl,[9] Graham[6] and Morton.[11] Wangensteen[14] on the other hand, advises the use of cyclopropane with an intratracheal catheter. Occasionally, however, this author employs spinal anesthesia supplemented by cyclopropane. Several authors advocate the use of field block of the abdomen, supplemented by a variety of agents or technics, including nitrous oxide and ether, splanchnic block, sodium pentothal, and ethylene (Waugh and Neel,[15] Crile,[4] Horsely,[7] Allen[1]). In a series of seventy-five subtotal gastrectomies Phelps[12] and his co-workers use an intratracheal catheter with an inflatable cuff employing ether or cyclopropane. Although this last series is for subtotal gastrectomy, the authors mention that the principles of the anesthetic technic advocated apply in all types of gastric surgery.

CASE REPORT

The patient was a forty-one-year old white male with over twenty-three years' service in the Army of the United States. He was admitted to Torney General Hospital on June 17, 1944, with the chief complaint of cramp-like pain in the epigastrium for a period of about six months. The present illness began in October, 1943, with slight periods of indigestion. The patient was perfectly well, however, aside from these discomforts and was able to go about his military duties until January, 1944, when he noticed cramp-like pain in the epigastrium accompanied by vomiting about every third or fourth day. Bowel movements had been regular all during this period. There was no hematemesis nor melena. The patient's normal weight was 167 pounds and was 130 pounds on admission to the hospital. From May, 1944, until the time of admission to this hospital, the patient was treated with an ulcer regime at another military hospital with considerable relief of symptoms. His previous history was essentially irrelevant except for psoriasis which he had since 1924. Previous surgery included a bilateral inguinal herniorrhaphy in 1941 with no recurrence. The family history was non-contributory.

Physical examination disclosed a white male 62½ inches in height, weighing 130 pounds with evidence of recent weight loss, but otherwise in fairly good condition. There were lesions typical of psoriasis on the buttocks, legs, chest, hands, elbows, arms and scalp. The remainder of the physical examination was normal except for slight tenderness in the epigastrium on deep pressure. No abdominal mass could be palpated. Blood pressure was 117/74.

Preoperative laboratory studies revealed normal urine analysis, a red blood cell count of 4.2 million, hemoglobin 95 per cent, white blood cell count of 17,150, and a differential of 62 per cent polymorphonuclear cells, 36 per cent lymphocytes and 2 per cent eosinophiles. Blood Kahn was negative. Gastric analysis showed 36 units of free hydrochloric acid and 68 units of total acid in the fasting specimen. Plasma proteins were 5.82 Gm. per cent and the icteric index was 5. Gastrointestinal roentgenograms taken on admission revealed a filling defect in the antrum of the stomach, approximately 6 cm. long extending to the pylorus. (Fig. 1.) The defect for the most part was on the greater curvature. The stream of barium through the defect was very narrow. This was constant when compared with previous gastrointestinal series taken seven weeks previously at another hospital. The *x*-ray diagnosis was carcinoma of the antrum of the stomach.

For two days prior to operation, the patient was prepared by nightly gastric lavages with dilute sodium bicarbonate solution and with intravenous therapy consisting of 1 liter of 5 per cent glucose in normal saline daily in addition to a soft ulcer diet. Thiamine chloride was also administered intravenously in doses of 50 mg. daily for these two days. On June 26, 1944, nine days after admission, the patient was subjected to total gastrectomy and splenectomy.

A transverse incision was made across the upper abdomen completely transecting both recti muscles. On the left side, this incision was extended upward at a right angle for about 6

inches. (Fig. 2.) The stomach was exposed and found to be much smaller than normal. The walls were heavily indurated and thickened. Grossly it had the appearance of a typical leather bottle stomach. (Fig. 3A.) Along the lesser and greater curvature, the texture of the stomach was rough. The great omentum along the greater curvature was thickened and indurated and gave the appearance of metastatic involvement. The first part of the duodenum was greatly dilated giving the impression of a diverticulum. There were strong fibrous adhesions between the first part of the duodenum and the omentum. The liver was smooth and glistening with no evidence of metastases. A few small glands were noted in the mesentery of the small bowel, two of which were removed for immediate microscopic examination and were reported as inflammatory. As the entire stomach from the duodenum to the esophagus was involved, total gastrectomy was elected. In attempting to expose the cardiac end of the stomach, enlargement of the spleen and dense adhesions fixing it to the cardia at the esophageal junction were encountered. This necessitated splenectomy. The common bile duct was exposed.

The first part of the duodenum just beyond the pyloric valve was then freed above and below and clamped across with two crushing clamps. The duodenum was transected between clamps with the cautery. The distal end of the duodenum was inverted with No. 00 chromic catgut and reënforced with a second layer of Lembert sutures, and a third layer of interrupted silk. The duodenal stump was then buried into the head of the pancreas. The blood supply of the lesser curvature of the stomach was triply ligated with No. 0 chromic catgut and severed. Along the greater curvature most of the omentum was removed with the stomach. The stomach was elevated and traction was made downward exposing the esophagus. There was found to be approximately 1 to 1½ inches of the esophagus which was available for anastomosis. There was no gross evidence of involvement of the esophagus in the carcinomatous growth. A long loop of the jejunum was isolated and brought up antecolic and anastomosed to the esophagus by a few inter-

FIG. 1. Preoperative *x*-ray showing a large filling defect in antrum of stomach.

rupted sutures of silk. A second posterior layer of continuous No. 00 chromic catgut was placed and this suture was left attached and placed in a sterile towel for future use. The jejunum was attached to the esophagus with the stomach *in situ*, employing the latter for traction. After completion of the two posterior layers, the esophagus was clamped across close to the suture line and transected with the cautery. An opening was made in the jejunum along the suture line corresponding to the open end of the esophagus. A running lock stitch of No. 00 chromic catgut was used to approximate the mucosa of the jejunum and the esophagus and was continued anteriorly as a Connel stitch. This was then reënforced with a layer of Lembert sutures which was a continuation of the previously placed posterior layer. The two layers were then reënforced with an interrupted layer of silk. Silk sutures were placed on each side of the anastomosis to approximate the suture line to the diaphragm, thus preventing tension upon the suture line postoperatively. (Fig. 3B.) A piece of the omentum was brought up and sutured to and around the suture line for future reënforcement and safety. Sulfanilamide crystals were sprinkled in this area and around the closed stump of the duodenum.

FIG. 2. Photograph of patient showing healed transverse incision with upward extension.

Before the abdomen was closed, a Miller-Abbott tube was passed by the anesthetist and threaded through the anastomosis between the esophagus and jejunum into the efferent loop of the jejunum (Fig. 3D) to prevent undue distention of the bowel postoperatively and to provide for postoperative feeding. The abdomen was then closed in layers without drainage.

Premedication consisted of 10 mg. of morphine sulfate and 0.4 mg. of scopolamine hydrobromide seventy-five minutes prior to the induction of anesthesia. Induction was accomplished with nitrous oxide and supplemented by ether, employing the circle filter absorption technic. Fifteen minutes after the induction of anesthesia, intratracheal intubation, employing direct vision with a catheter upon which an inflatable cuff was mounted, was performed. The cuff was then inflated to rest snugly against the trachea, thus isolating it from the pharynx and the esophagus. Preoperative blood pressure and pulse were 135/80 and 92, respectively. Except for a short period of hypotension of 80/60 due to traction on the stomach, the course was completely benign through the operation.

The pathological report was as follows: *Gross:* The specimen consisted of a stomach

amputated at the esophageal junction with the cardia and a small portion of the first part of the duodenum. The consistency of the wall ently fibrous in character. The muscularis was hypertrophied. No tumor tissue was grossly evident. *Microscopic:* Sections taken from all

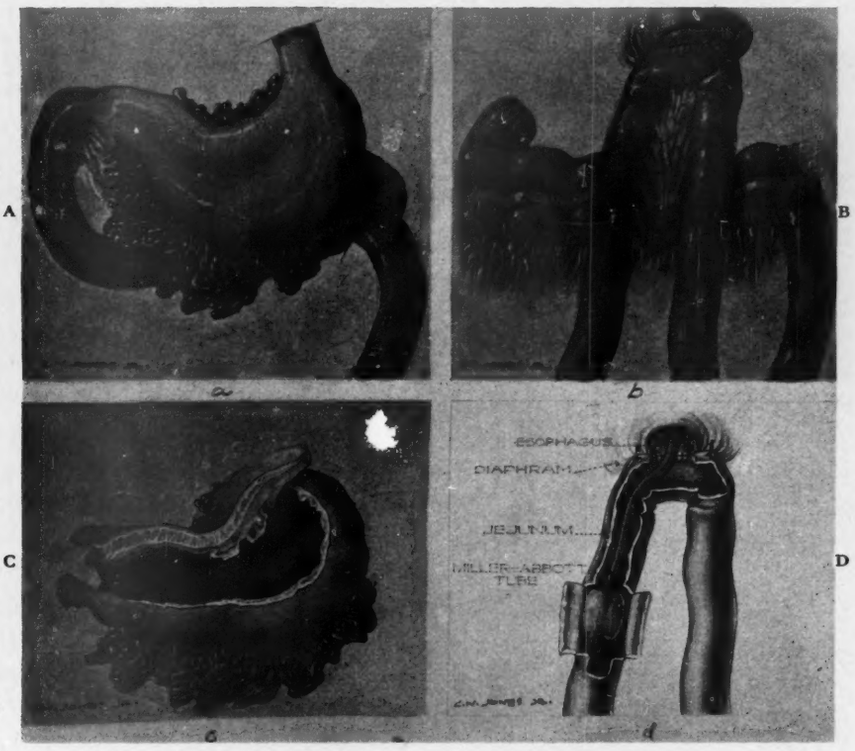

FIG. 3. A, gross appearance of stomach, typical "leather bottle" type. B, anastomosis of esophagus to jejunum showing silk suture along each side approximating suture line to diaphragm. C, stomach opened showing thickened and indurated walls. D, Miller-Abbott tube passed through anastomosis between esophagus and jejunum.

of the stomach was firm and stiff, being board-like in the region of the lesser curvature. These changes ended abruptly at the pylorus and the color and consistency of the duodenum were normal. The lumen of the stomach held about 130 cc. of fluid.

On opening the stomach, the mucosa was thrown into heavy folds, especially in the pyloric region. (Fig. 3C.) There was no fungating tumor mass and no definite ulceration. The wall of the stomach was very thick, measuring up to 1.5 cm. in the prepyloric region especially along the lesser curvature. The submucosa was thickened throughout, but especially in the pyloric and prepyloric regions, as well as at the cardia. The thickening of the submucosa of the cardia extended into the submucosa of the esophageal stump. This thickening was due to the presence of a whitish fibrous tissue which was very dense. It extended into the muscular coats separating individual muscle bundles. The subserosa was also thickened and apparportions of the stomach revealed essentially the same findings. The diagnosis is carcinoma of the stomach, diffuse, scirrhous type (linitis plastica).

Table 1 reveals in summary form, the postoperative regime which was followed, including parenteral therapy, drugs administered and observations of laboratory data. The salient points consist of the care in providing whole blood, protein, carbohydrate, water salt and the vitamins in proper quantities as well as exercising the usual precautions in the prevention of the postoperative complications common to gastric surgical patients.

After the immediate postoperative period, the patient did very well and was up and about taking progressively larger oral feedings. However, approximately three months after operation, signs of metastatic involvement in the chest and abdomen developed. The course was downhill from mid-September, 1944, until death occurred on October 21, 1944, (four months after operation) from extensive metas-

TABLE I

POSTOPERATIVE DATA

Date 1944	RBC	Hb	WBC and diff.	Platelets	Character of Red Cells	Urine	Intake	Medications	Remarks
26 June	....	....	.....	.....	.....	.....	1500 cc Plasma 500 cc Blood 1000 cc N/Saline 50 gm Glucose	Thiamine Chloride 5 mg.	Operative Day O_2 Tent
27 June	3.78	80%	17,900 92% Polys	.....	Moderate poikilocytosis	Trace Glucose	1000 cc Plasma 1000 cc N/Saline 1000 cc 0.5% Saline 100 gm Glucose 50 gm Protein	Sulfadiazine gms 4 Thiamine Chloride 5 mg	O_2 Tent Cough Plasma Reaction
28 June	....	....	.....	.....	.....	Normal	500 cc Blood 1000 cc N/Saline 2000 cc 0.5 " 150 gm Glucose 100 gm Protein 240 cc H_2O orally	Thiamine 5 mg. Sulfadizaine 4 gm. 100 mg. Vit. C	Blood Sulfadiazine 6.7 mg. O_2 Tent Plasma Reaction
29 June	4.38	90%	16,800 73% Polyps	.....	Normal	.....	2000 cc 0.5% Saline 1000 cc Distilled H_2O 1000 cc N/Saline 250 gm Glucose. 100 gm Protein 400 cc H_2O orally	Sulfadiazine 4 gm. 10 mg. Thiamine 100 mg. Vit. C	O_2 Tent Temp. Normal
30 June	....	....	.....	.....	.....	Heavy Trace Glucose	2000 cc 0.5 Saline 1000 cc N/Saline 150 gm Glucose 100 gm Protein 300 cc H_2O orally	Sulfadiazine 4 gm 100 mg. Vit. C 10 mg. Vit. B	O_2 Tent Serum Prot 4.98 A/G ratio 1.6/1 Blood Chloride 455 mg.
1 July	4.03	90%	7,280 74% Polys 24% Lymph 2% Eosin	196,000	Normal	..... Glucose	1000 cc Dist. H_2O 3000 cc 0.5% Saline 250 gm Glucose 150 gm Protein 400 cc H_2O daily	Sulfadiazine 4 gm Thiamine Chl. 20 mg. Vit. C 100 mg.	Bl. Sulfa 3.7% O_2 Tent
2 July	....	....	.....	.....	.....	.....	2000 cc Dist. H_2O 1000 cc N/Saline 200 gm Glucose 400 cc H_2O orally	Vit. C 100 mg. Thiamine 10 mg.	O_2 Tent discont. Sulfadiazine cont.
3 July	4.07	90%	7,600 65% Polys 33% Lymph 1% Eosin 1% Baso	208,000	Normal	Nromal	2000 cc Dist. H_2O 1000 cc N/Saline 1000 cc 0.5% " 300 gm Glucose 50 gm Protein H_2O freely orally	Thiamine Chl. 20 mg. Vit. C 100 mg	"Hunger" pains
4 July	....	....	.....	.....	.....	.....	1000 cc Dist. H_2O 1000 cc N/Saline 1000 cc 0.5% " 200 gm Glucose 50 gm Protein H_2O freely orally	Vit. C 100 mg Thiam. Chl. 15 mg.	
5 July	....	....	.....	.....	.....	.....	1000 cc 0.5% Sal. 50 gm Glucose 50 gm Protein supplemented with strained fruit juices and broth.	Vit. C 100 mg.	Miller-Abbott tube removed. Stool.
6 July	4.00	80%	9,400 74% Polys 26% Lymph	203,000	Normal	Normal	O.K.	.....	Serum Prot. 4.95 gm A/G 2.6/1
7 July	....	....	.....	.....	.....	.....	.....	.....	Retention sutures removed. Hematoma of wound.
8 July	4.41	85%	8,900 61% Polys 31% Lymph 3% Eosin	204,000	Normal	Normal			
10 July	4.38	85%	8,300 60% Polys 26% Lymph	28,200	Normal	Normal	.....	Liver ext. 2 cc I.M. every week	
11 July	Lab data normal from this date to present date of 8 August 1944								Out of bed.

tases to the peritoneum, both pleurae, and the abdominal lymph nodes, verified at autopsy. The esophagojejunal anastomosis was patent.

COMMENT

The case reported is presented not because of its rarity, but because it demonstrates a number of interesting features which are of general interest. This case exemplifies the fact that the necessity for total gastrectomy cannot be anticipated prior to laparotomy for carcinoma of the stomach. Because of the radiographic evidence, it was thought preoperatively that a subtotal gastrectomy would be the operation of choice, and that there would be ample normal stomach to make this procedure feasible. However, when the abdomen was opened, the stomach was of the "leather bottle type" and completely involved. It was necessary to perform a total gastrectomy or close the abdomen without further operative interference. The former was elected.

The type of incision used in this case proved to be very useful and gave excellent exposure. To our knowledge, the incision described in the section on operative technic has not been reported previously. Mobilization of the left lobe of the liver was obviated as a result of the exposure afforded by the incision. The wound healed by primary intention and there was no evidence of a postoperative hernia nor weakness of the abdominal wall. (Fig. 2.)

In this case the Miller-Abbott tube was inserted at the time of operation and was threaded through the esophagojejunal anastomosis and passed into the efferent loop, obviating the necessity of performing enteroenterostomy or jejunostomy. Subsequent results justified this decision and unquestionably had a marked influence on the smoothness of the postoperative convalescence.

Splenectomy was necessary to permit adequate exposure of the esophagus as the spleen was densely adherent to the cardia by strong fibrous adhesions. The spleen was removed without incident and did not add to the operative risk or apparently complicate the postoperative blood picture.

The postoperative roentgenogram revealed a well functioning esophagojejunostomy. (Fig. 4.) There was some compensatory dilatation of the esophagus which explains the patient's ability to tolerate feedings without distress. It was anticipated that in time the jejunal loops would also participate in the dilatation.

Fig. 4. Postoperative *x*-ray showing well functioning esophagojejunostomy.

In considering the method of anesthesia, the technic employed was selected because of certain advantages. The intratracheal tube with an inflatable cuff isolates the pharynx and the esophagus from the trachea, and thus prevents aspiration of gastric contents, during manipulation of the stomach and minimizes the opportunity for postoperative respiratory complications. From the standpoint of the surgeon, this method of anesthesia provides

for adequate relaxation of the abdominal wall and for smooth operating conditions, while maintaining absolute control of the airway. Finally, the employment of this type of intratracheal catheter facilitates the passage of the Miller-Abbott tube during the operation. This is considered the ideal time for this procedure.

It is apparent that a vital factor in the success of total gastrectomy is the proper management of the complications induced by enforced starvation and all its implications. Strict attention to nutritive demands pre- and postoperatively is required. This means the intelligent and carefully controlled administration of whole blood, water, salt, protein, carbohydrate and the water soluble vitamins by parenteral routes. Table 1 indicates the method of applying these principles practically.

As soon as possible, small oral feedings should be instituted. It is wise to wait until the seventh day for the administration of solid foods and small and frequent feedings are tolerated best until compensatory dilation of the esophagojejunal anastomosis takes place.

The operation of total gastrectomy is indicated for any growth which extends high on the lesser curvature, for massive tumors of the fundus, for growths involving the cardiac end of the stomach, and for cases of linitis plastica. This operation may be performed if there is enough mobility of the stomach and of the abdominal esophagus to do an esophagojejunostomy. It is not essential to perform a jejunojejunostomy nor to insert an enterostomy tube. The mortality rate for total gastrectomy ranges from 32 to 64 per cent as most of the patients are poor risks and the operation is technically difficult. However, the risk is justifiable in otherwise hopeless cases. Life may be prolonged even if the prognosis for permanent cure is not good. It has been stated that only 2 to 4 per cent of the total number of patients operated upon for gastric carcinoma will be alive at the end of five years. However, as the experience of total gastrectomy increases and the technics improve so that the immediate mortality rates decrease, it is reasonably certain that the statistics for the complete five-year survival for cases of gastric carcinoma will improve. Although a patient's condition is improved only temporarily, it is certain that he will have a much more pleasant life and that the terminal state will be easier. It certainly justifies the application of radical resection to any patient who has a chance of cure, and also justifies the practice of removing all so-called benign tumors by wide dissection.

SUMMARY AND CONCLUSIONS

1. A report of a case of scirrhous carcinoma of the stomach of the linitis plastica type subjected to total gastrectomy is presented.

2. Total gastrectomy is justified, despite its high moratlity rate, for massive tumors of the fundus, growths extending high on the lesser curvature or involving the cardiac end of the stomach, and for linitis plastica.

3. Since total gastrectomy cannot always be anticipated prior to surgery, laparotomy for carcinoma of the stomach should be performed only by those surgeons qualified to do this formidable procedure.

4. The incision advocated for this procedure is transverse transecting both recti muscles and augmented by a left paramedian extension.

5. A Miller-Abbott tube in the efferent jejunal loop will alleviate postoperative ileus if such develops and obviates the necessity for jejunostomy. The proper time for insertion is during operation.

6. Splenectomy, if necessary for better exposure, does not add to the operative risk nor does it complicate the postoperative course.

7. Intratracheal anesthesia employing an inflatable cuff is the anesthetic procedure of choice.

8. The pre- and postoperative management is directed towards the attainment of an optimum state of nutrition. Particular

emphasis, postoperatively, should be placed on the administration of protein.

9. These patients are not necessarily limited permanently to frequent small feedings as compensatory esophagojejunal dilatation allows for eventual adequate capacity for food.*

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* Photographs were taken through the courtesy of the United States Army Signal Corps.

To increase exposure, especially in the upper abdomen, a transverse incision may be made through the skin and anterior and posterior sheaths of the rectus muscle at right angles to a median incision. This type of exposure may be indicated in certain operations upon the gallbladder, stomach, pancreas, spleen, and transverse colon.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

MULTIPLE ARGENTAFFIN TUMORS (CARCINOIDS) OF THE RECTUM*

R. H. RIGDON, M.D.
Professor of Pathology, School of Medicine, University of Arkansas

AND

D. E. FLETCHER, PH.D.
Instructor in Pathology, School of Medicine, University of Arkansas

LITTLE ROCK, ARKANSAS

ARGENTAFFIN tumors (carcinoids) occurring within the intestinal tract cannot be considered a rarity. Porter and Whelan[5] reported ten cases observed in 2,922 autopsies; Humphrey[4] found eight in 3,200 autopsies and Raiford[6] observed twenty-nine among 62,000 specimens including both autopsy material and those removed at operation.

Carcinoids may occur in any part of the intestinal tract; their distribution, however, is interesting. Argentaffin tumors are seen almost twice as frequent in the appendix as in the small intestine. Their occurrence in any other portion of the intestinal tract is rare.[5] Porter and Whelan cites cases in which this lesion occurred in the stomach, gallbladder, Meckel's diverticulum, cecum and in the colon.[5]

The rectum apparently is one of the least frequent sites in the entire gastrointestinal tract for carcinoids. In 1942, Stout found six cases reported in the literature and added six.[7] We have found only one case of a carcinoid tumor in the rectum reported since 1942.[8]

A case of multiple carcinoids in the rectum was recently observed at autopsy. It is reported firstly, since the previously reported cases had only a single tumor nodule, and secondly, because of the infrequency of carcinoids in the rectum.

CASE REPORT

The patient, a colored male, age sixty, was admitted to the hospital with the chief complaint of "shortness of breath." Death occurred approximately twenty-four hours later from a rupture of a dissecting aneuryam of the aorta.

The significant lesion, from the standpoint of this paper occurred in the rectum. Innumerable nodules varying in size from a few millimeters to 1.0 cm., were present beneath the mucosa of the rectum. The nodules were relatively freely movable. They were rubbery in consistency and on cut section they were grayish-white. The entire rectum was so extensively involved by the tumors that it was impossible to touch the mucosa without also touching several tumors. The mucosa was normal and the wall of the rectum was not significantly increased in thickness by the presence of the tumors. (Fig. 1.)

The tumors were formed by varying sized groups of epithelial-like cells. Some of these cells were oval, while others were round. The arrangement of the tumor cells varied widely in the different nodules. (Figs. 2 and 3.) Sometimes these cells were in clusters and at other times the arrangement suggested a gland. Varying amounts of stroma separated the groups of tumor cells. The tumor nodules extended from the mucosa to the muscle. In some sections the neoplastic cells extended down into the muscle. Small granules were present in the cytoplasm of these tumor cells. After impregnation with an ammoniacal silver, some of these granules were black while others were yellowish-brown in color. (Fig. 3c.)

COMMENTS

This case of argentaffin tumors (carcinoids) of the rectum differs from those reported by Stout[7] in that the lesions are multiple while only a single nodule occurred in each of the previously reported cases. The location of the tumor nodules in the submucosa with extension into the muscle is frequently seen in this type of neoplasm. The cellular morphology and the staining reaction is consistent with tumors arising from the argentaffin cells in the glands of the intestinal tract.

* From the School of Medicine, University of Arkansas, Little Rock, Arkansas.

Although there has been some controversy between investigators as to the origin of this type of tumor, the concensus at this time is that they arise from the argentaffin cells in the crypts of Lieberkühn. Ariel,[1] Forbus,[3] Porter and Whelan,[5] Raiford[6] and Stout[7] have reviewed and discussed the histogenesis of carcinoids.

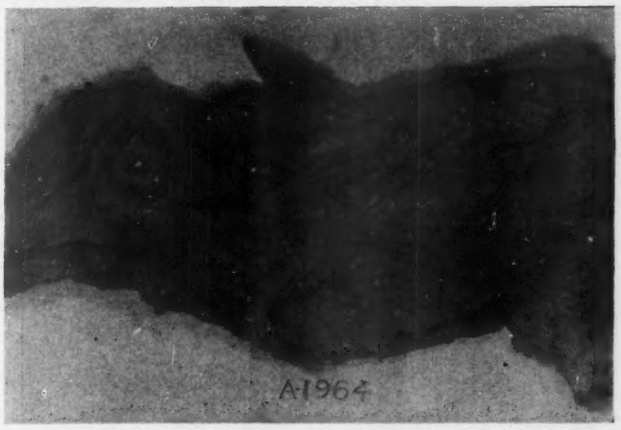

Fig. 1. Rectum with the anal margin to the right. The individual tumor nodules are small and distributed throughout the submucosa.

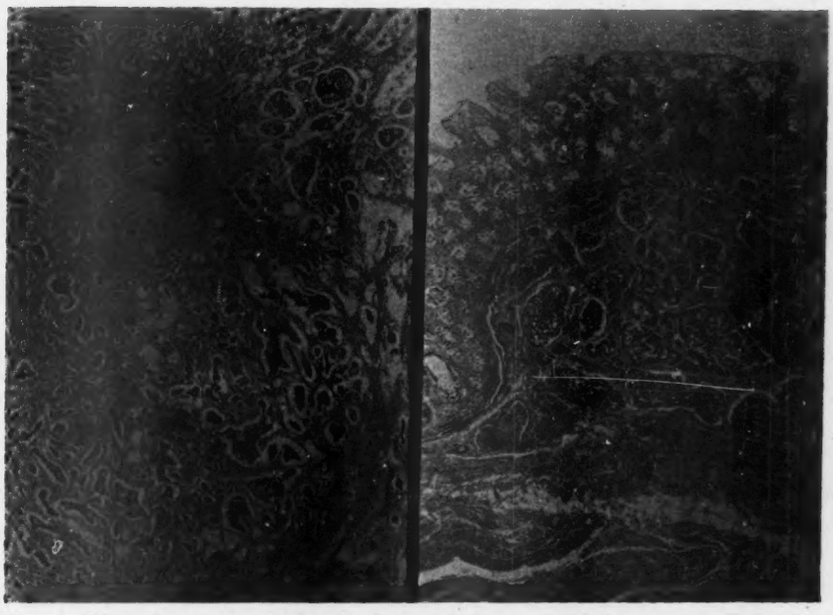

Fig. 2. There is some variation in the type of growth of the tumor cells in the different nodules.

Multiplicity of carcinoid tumors is frequent although this cannot be regarded as typical of this type of neoplasm. These tumors are usually small nodules in the submucosa of the bowel. They are firm, rubbery, and move freely beneath the mucosa. They may assume a pedunculated form according to Raiford.[6] These tumors usually are small, however, large ones have been observed. The latter tumors may be more difficult to move when they extend down into the muscularis.

In Raiford's series of twenty-nine cases of carcinoids all of those occurring in the stomach and colon were malignant while only one was malignant in the group of seventeen from the appendix.[6] Cooke[2] found twenty-one malignancies in 104 cases of carcinoid tumors of the small intestine. There were two malignant car-

cinoids in the rectum in the group of twelve cases reported by Stout.[7] It is safe to say that argentaffin tumors are potentially malignant, however, their grade of malignancy is usually quite low.[5]

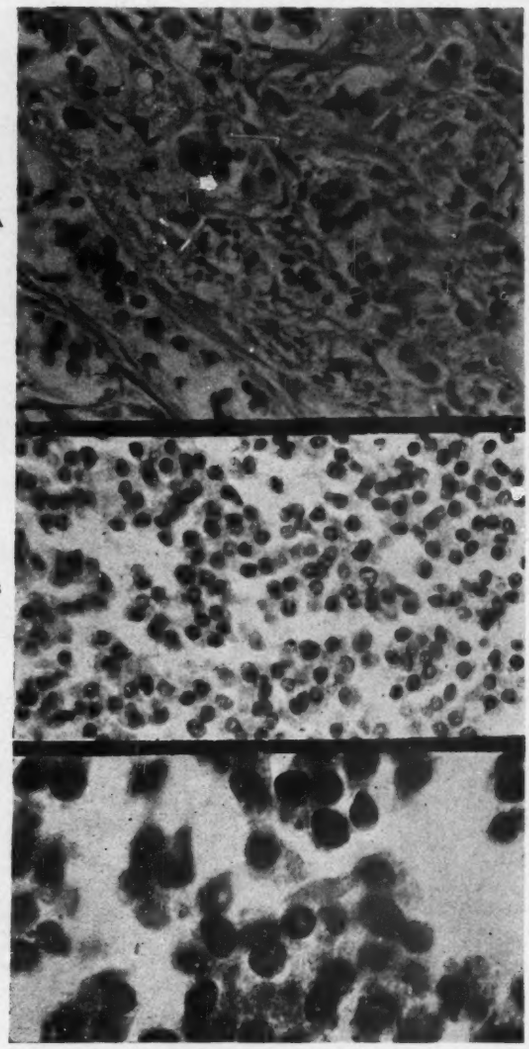

FIG. 3. The variation in the type of growth of the tumor cells is shown in A and B. The silver staining granules in the cytoplasm of the tumor cells are shown in C (ammoniacal silver preparation).

Whenever an atypical tumor is found within the intestinal tract one should think of a carcinoid. Yaker says that "unless kept constantly in mind, the diagnosis is apt to be overlooked by both the clinician and pathologist."[8]

SUMMARY

A case of multiple argentaffin tumors (carcinoids) occurring in the rectum is reported from an autopsy case. The wall, for approximately 15 cm. was infiltrated with nodules varying in diameter from a few millimeters to 1.0 centimeter. The surface over these tumors was not ulcerated and there was no evidence of metastases. Apparently this is the fourteenth case of an argentaffin tumor occurring in the rectum to be reported, and the first case in which the nodules are multiplied.

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RECONSTRUCTION OF THUMB

LIEUT. COL. JAMES M. BEARDSLEY AND MAJ. VINCENT ZECCHINO
MEDICAL CORPS, ARMY OF THE UNITED STATES

A CHINESE soldier was admitted to the hospital on August 10, 1944. He had sustained a severe shrapnel wound of the left hand about one month prior to entry.

Examination revealed complete loss of the left thumb including the entire metacarpal bone and the thenar eminence. By *x*-ray there was a healed fracture of the mid-shaft of the second metacarpal with lateral angulation of the fragments. Multiple small opaque foreign bodies were observed in the soft tissues. (Fig. 1.) An open wound on the lateral surface of the hand, measuring 8 cm. by 3.5 cm., was covered with fairly clean granulations. (Fig. 2.)

Because of the grotesque appearance presented by the loss of the thumb and thenar eminence, it was devised to reconstruct a new thumb. It was also hoped that some functional benefit would be derived from the operation.

At the first stage, on August 14, 1944, a tubed pedicle flap was fashioned from the tissues of the lower anterior chest wall. (Fig. 2.) A section of bone, about 7.5 cm. by 0.5 cm., was removed from the anterior surface of the left tibia and enclosed in the pedicle. The size and position of this bone is outlined in ink on the skin surface in Figure 2 and shown by *x*-ray in Figure 7. All incisions healed by first intention and at no time was there any drainage from the pedicle incision, or inflammation indicating foreign body reaction.

At the second stage, on September 8, 1944, the wound edges on the dorsum of the hand were excised. The inferior portion of the pedicle was elevated through a curved incision corresponding with the dorsal defect. The hand was then brought up to the chest and the two incision lines sutured with interrupted silk. A plaster jacket maintained the arm in position, a window being cut for dressings and removal of sutures.

It was decided not to detach the pedicle completely at a single stage although it is quite possible that this could have been accomplished. By using the two-step method an additional blood supply was ensured when complete severance of the pedicle was carried out.

The third stage was performed on September 24, 1944. The remainder of the wound edge on the palmar surface was excised, the division

FIG. 1. *X*-ray of hand at the time of admission.

of the pedicle completed, and sutured into position to close the hand defect. (Fig. 4.) The arm was again immobilized in plaster with a window cut out to allow for dressings.

At the fourth stage, on October, 1944, after measuring the thumb on the right hand, the pedicle was divided at a point that allowed for similar length to the reconstructed thumb. The stump was closed with a long anterior and short posterior flap. (Figs. 5 and 6.) The unused portion of the pedicle was excised in the usual manner.

COMMENT

One modification in the above procedure might have been advisable. When the pedicle was divided for attachment to the hand, Thiersh grafting of the chest wall

FIG. 2.

FIG. 3.

FIG. 2. Showing hand defect and pedicle, with size and position of bone transplant outlined on skin.
FIG. 3. The inferior portion of the pedicle has been raised and attached to the dorsum of the hand.

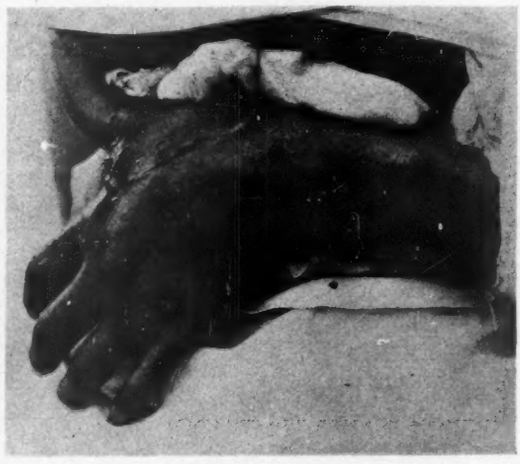

FIG. 4. Pedicle detached from chest wall and closure of hand defect now completed.

defect could have been done immediately, returning the flap to its original position. Then, when it was attached to the hand, however, were noted: The reconstructed digit was firm with no tendency to be floppy. This was due to two factors: First,

Fig. 5. Fig. 6. Fig. 7.

Figs. 5 and 6. Reconstructed thumb after completion of operations.
Fig. 7. *X*-ray of hand showing bone transplant.

no raw surface would have been present. Since the division of the pedicle was accomplished in two stages, this would have necessitated two additional operative steps. The drainage from the raw surface caused no problem in this case and final Thiersh grafting of this defect was carried out after reconstruction of the thumb had been completed.

The final cosmetic result would alone seem to justify this operation, which is essentially a simple procedure. It was possible to follow up this case for only a brief period so that claims for improved function of the hand must be guarded. Certain facts, the presence of the transplanted bone in the shaft, and second, its broad attachment to the hand, allowing for a wide area of scar tissue formation.

The functional accomplishment in this case may be summed up by saying that the patient has been given a stiff thumb which has no motion but is present in a normal anatomical position, and against which the fingers may be opposed, thus allowing for a certain amount of grasping power.

The advisability of grafting the tibial transplant to the carpus was considered but the probability of its being easily fractured discouraged this idea.

OSTEOMYELITIS OF THE FRONTAL BONE AND SUBDURAL EMPYEMA WITH RECOVERY

SIDNEY W. GROSS, M.D.
NEW YORK, NEW YORK

ALTHOUGH subdural empyema (abscess) secondary to suppurative frontal sinusitis has been recognized for fifty or more years, the literature concerning this ominous complication is meager. In recent years Courville,[1] and Kubik and Adams[2] have made significant contributions to the study of this subject. Courville's paper includes an up-to-date review of the literature and a report of forty-two cases of subdural empyema secondary to suppurative frontal sinusitis verified at autopsy. Since recovery from subdural empyema is so infrequent it was deemed worthwhile to describe in detail the clinical course and mode of treatment in a successful case.

CASE REPORT

R. L. G., a white male, twenty-eight years old, a clerk in the United States Army, had always been in good health up to September 4, 1944, when he developed an acute upper respiratory infection. On September 8, 1944, he developed pain in the left frontal area extending over the left eye. Examination at that time was reported to show a swelling of the left frontal area and a purulent discharge from both nares. His temperature varied from 99° to 100.4°F. On September 12, 1944, he complained of headache and nausea and he vomited several times. He was treated in the Out-Patient Department with a nasal spray of cocaine and ephedrine. *X*-ray examination showed clouding of both frontal sinuses with sclerosis of the bone around the left frontal sinus. From September 17 to September 24, 1944, he received 20,000 units of penicillin every four hours. A culture of the nasal discharge at this time yielded Staphylococcus albus and hemolytic staphylococcus aureus. On September 28, 1944, an abscess of the left side of the forehead was incised and drained. He failed to improve and continued to complain of severe pain in the head and general malaise. On October 7, 1944, he was transferred by air from a United States Army Station Hospital in Canada to a General Hospital in the United States. Upon arrival he was drowsy and disoriented. There was a swelling of the scalp in the left frontal area. A few hours after admission a bilateral radical frontal sinusotomy was done. This disclosed osteomyelitis of the skull and an epidural abscess; 25,000 units of penicillin were given on admission and continued every three hours. On October 8, 1944, a right-sided hyperreflexia was noted. The patient seemed to ignore the right side of his body. He pointed correctly to a few parts on the left side of his body but was unable to point to any part on the right side. He had a marked expressive aphasia. A lumbar puncture showed a pressure of 390 mm. of water. At 2 P.M. on October 8, 1944, he had a Jacksonian seizure which began on the right side of the face and spread to the right upper and lower extremities. The patient was considered "too sick to move by air or rail" at this time. He was given 5 Gm. of sodium sulfadiazine intravenously. The patient's temperature was 103.6°F.

The patient was transferred to another General Hospital by air on October 9, 1944, and came under the author's observation at 6:30 P.M. on that day. On examination the patient appeared critically ill. He was in deep stupor but moved about slightly on painful stimulation. There was slight neck rigidity and a bilaterally positive Kernig. Both optic discs showed slight blurring. There was a right hemiplegia with a positive right Babinski sign. *X*-ray examination of the skull showed a moth eaten appearing area of bone destruction about 3 by 3 cm. in the left frontal area. A lumbar puncture showed a pressure of 230 mm. of water. The fluid was clear but contained 215 cells per cubic mm., 67 per cent were polymorphonuclears and 23 per cent were lymphocytes. Culture showed no growth (later report). Blood count was: red blood cells 2,750,000; white blood cells 16,000, 88 per cent polymorphonuclears and 12 per cent lymphocytes; temperature was 101.8°F.; pulse 88; blood pressure 156/70.

Operation was begun at 10:50 P.M. October 9th and lasted to 12:40 A.M. October 10, 1944. With the use of local anesthesia the incision of the previous bifrontal radical sinusotomy was reopened and extended laterally to the left. A new incision was made beginning at the glabella and extending in the sagittal plane to about 3 cm. beyond the hair line and then laterally to the left temporal region. (Fig. 1.) Michel clips were applied to the wound edges and these were left in place for three days to control bleeding. The scalp flap including the periosteum was stripped from the bone. The outer table of the skull appeared roughened and of increased vascularity in the left frontal area, corresponding to the area of bone destruction noted in the *x*-ray film. An opening was made in the skull with perforator and burr. Pus was present in the diploic spaces. All the diseased tissue was removed with rongeurs well out into normal appearing bone. A few granulations were present on the dura. After preparing a small area with iodine and alcohol the dura was punctured with a fine needle. Pus was obtained from the subdural space. The dura was then opened widely in all directions. A large amount of pus escaped and was removed by suction. The pus extended laterally to the temporal region and posteriorly to the parietal region. Rubber tissue drains were inserted into these areas and along each a Dakin tube was placed so that penicillin could be instilled locally without disturbing the dressing. Gauze packs saturated in a solution of penicillin containing 500 units per cc. were placed on the dura. The scalp flap was then loosely sutured in place with a few silkworm gut sutures. The wound was then sealed. The patient was turned over and re-draped to expose the left occipital area. The skull was opened and even though the dura appeared normal a rubber tissue drain was placed in the subdural space. This was done because of the author's experience with previous unsuccessful cases of subdural empyema in which autopsy showed loculation of pus in the occipital region. A transfusion of 500 cc. of whole blood was given during the operation.

The patient seemed more alert following the operation. He had two right-sided Jacksonian seizures the following morning. Nasal oxygen and penicillin 20,000 units every three hours were started on return to the ward. He began to move his right arm on the morning following operation. Transfusions, each of 500 cc. of whole blood, were given on October 10th and October 11th. The patient's favorable course is best pictured by the temperature chart. (Fig. 2.) On October 15th the patient was alert and was able to talk in single words. Beginning immediately after operation 30 cc. of penicillin (500 units per cc.) were injected into the wound twice a day by means of the Dakin tubes. The wound was dressed on the third postoperative day and the Michel clips removed from the scalp edges. On October 16, 1944, one week following operation the second dressing was done. The wound was clean and free of pus at this time. The patient's improvement was rapid. On November 6, 1944, under intravenous sodium pentothal anesthesia a secondary closure was done. The author was transferred to overseas duty at that time. Follow-up was maintained by mail. The patient's letters showed no evidence of any language defect. A letter received in October, 1945, one year following surgery, stated that a tantalum cranioplasty had been done and that the patient considered himself to be in normal health.

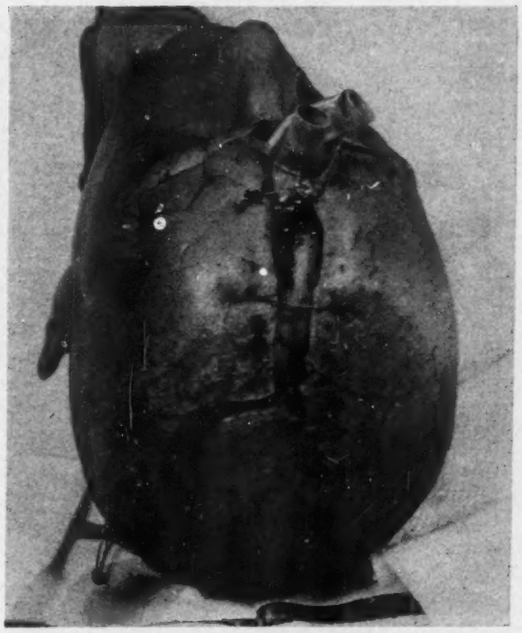

FIG. 1. Appearance of wound one week after operation.

COMMENT

In the author's previous experience with cases of subdural empyema he had never obtained a cure. The method of treatment was in every major respect similar to that used in the present case with one important

exception. This was the first case in which penicillin was used. However, the favorable result cannot be attributed solely to the use of penicillin since the patient was adequately treated with this agent prior to surgery without any influence on his progressive downhill course. At the time of operation he was almost moribund, much worse than any case of subdural empyema which had previously come under the author's care. He recovered promptly following adequate surgery combined with systemic and local penicillin and transfusions.

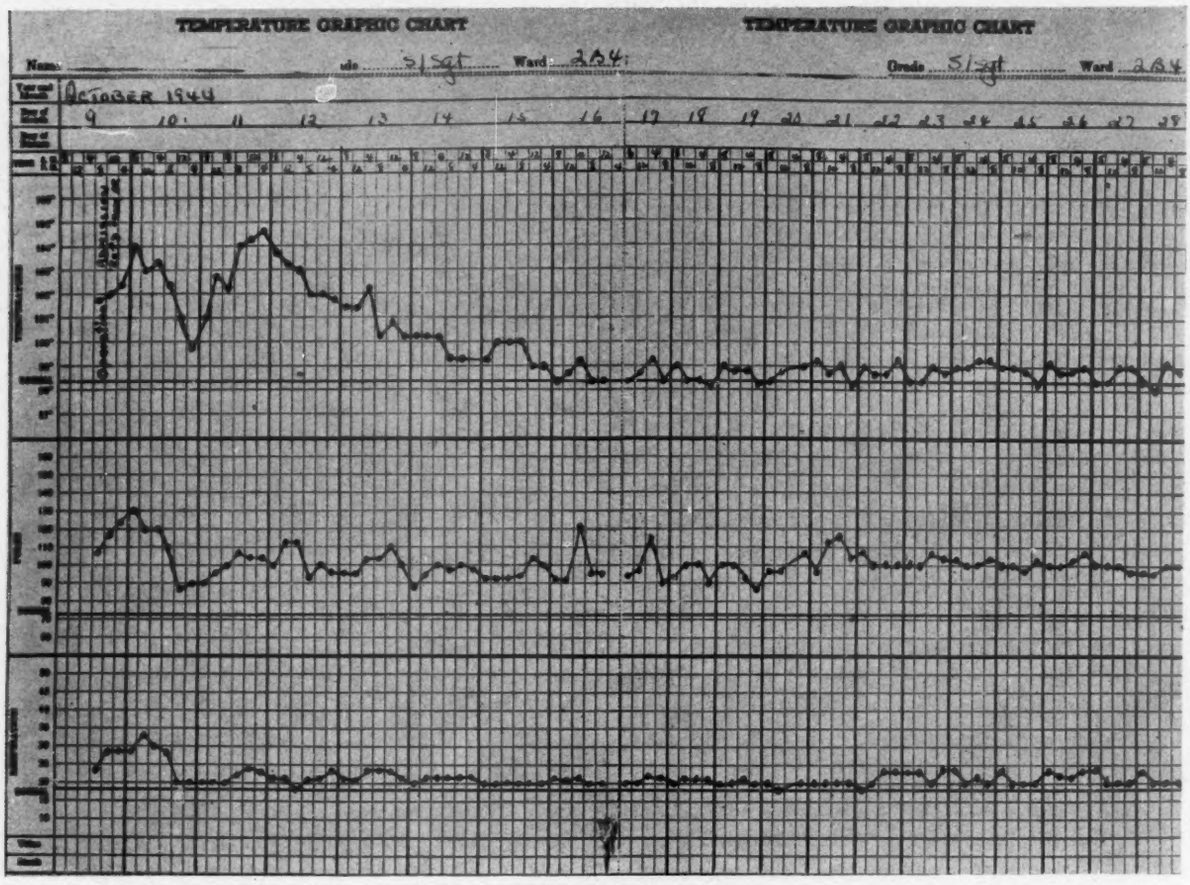

FIG. 2. Temperature graph.

It was fortunate that the organism responsible for the infection was extremely susceptible to penicillin. The laboratory reported the organism to be "a streptococcus viridans more susceptible to penicillin than the standard staphylococcus hemolyticus strain."

The clinical course in cases of subdural empyema secondary to frontal sinus infection has been adequately described by Courville and Kubik and Adams so that only the salient features will be reviewed. During an attack of acute frontal sinusitis or an acute exacerbation of chronic frontal sinusitis, the first sign of spread of infection to the subdural space may be a Jacksonian seizure on the contralateral side. After the initial seizure the course may be fulminating with headache, signs of focal involvement, such as hemiplegia and aphasia, then stupor and signs of systemic toxemia. Evidence of meningeal irritation is usually slight or absent and the spinal fluid only shows signs of mild irritation resulting from the contiguous infectious processes. If, in addition to the subdural empyema there is also a diffuse osteomyelitis of the skull, the scalp over the involved bone exhibits a typical doughy swelling.

The spread of infection from the frontal sinus to the subdural space has been adequately discussed by Courville. He believes that direct extension through an area of erosion in the posterior sinus wall to be rare and favors the pathway of the communicating veins as the most common route.

Treatment. Subdural empyema is a surgical lesion. Once the diagnosis is made exploration and drainage should be carried out without delay. The opening in the skull should be large enough to provide adequate drainage. Primary closure of the scalp flap is never justified. The surgeon should not be concerned with the size of the bony defect. Cranioplasty at a later date is far preferable than to risk inadequate drainage. In addition to surgery systemic and local penicillin in full dosage is indicated.

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Necrosis of bone is due to periostitis, osteitis, osteomyelitis, irradiation or injury. *Toxic necrosis* is caused by phosphorus or mercury, often in association with bacteria. *Senile necrosis* (*quiet necrosis*) follows traumatism, probably with a mild associated infection.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

HYPERPARATHYROIDISM DUE TO PARATHYROID ADENOMA

W. J. BIERMANN, M.D.
On Staffs of St. Francis, Wesley, Wichita and County Hospitals
WICHITA, KANSAS

THE following is a presentation of a very atypical case of hyperparathyroidism due to parathyroid adenoma, bringing out the difficulties of diagnosis, and also a review of the literature to present the difficulties encountered in the surgical removal of these adenomas.

CASE REPORT

CASE 1. No. 8685. A white female, age forty-four, was admitted to the hospital on September 17, 1936, with the following complaints: nausea and vomiting, frequency of urination and occasional sharp pain in the bladder like a knife sticking, a history of continuous dull ache in the right kidney region when walking a great deal for the past two years, and some weakness. Urinalysis revealed: albumin positive, specific gravity 1014, blood normal, few leucocytes and occasional hyaline cast. *X*-rays revealed the following: both kidneys appeared studded throughout with minute calcium deposits. The pelves were filled out and appeared normal; they were cleared of all symptoms in five days under routine urinary antiseptics. Skin tests, sputum, and *x*-ray of chest were all negative for tuberculosis. Blood calcium and phosphorus were normal.

On June 24, 1937, the patient was readmitted to the hospital complaining of nausea and vomiting and urinary frequency. Urinary findings were essentially the same as before. A complete gastrointestinal series did not reveal any pathological condition. Pelvic bones and *x*-ray of the skull did not show decalcification. An *x*-ray of the chest was normal. Blood calcium at this time was 14 mg. per 100 cc. of blood, and blood phosphorus was 2.5 mg. per 100 cc. of blood. Organic phosphatase was .15 mg. per cc. of blood. Under routine measures the urinary disturbance improved.

The patient, however, kept complaining of weakness and occasional vomiting spells. She lost weight and seemed to get progressively worse until six months later while walking she fell and broke both femurs. *X*-ray at this time revealed a definite decalcification and cystic formation throughout both femurs and also in the skull. Blood calcium at this time was 15.7 and the blood phosphate was 3 mg.; phosphatase (Bodinsky method) was 28 units. A diagnosis of parathyroid tumor was made but the patient's condition did not warrant any exploration at this time. Supportive splints and deep *x*-ray treatments were given over the parathyroid regions as a temporary measure, but with no apparent results. The blood calcium and urinary calcium kept on a continual rise although the blood phosphorus stayed about the same. After about two months of transfusions and other supportive measures the patient seemed to be in condition to explore the parathyroids.

The thyroid was exposed in the usual way by the collar thyroidectomy incision. The pretracheal fascia was opened in the midline. The strap muscles were divided high up on both sides between muscle clamps and reflected. The right side was first dissected by rotating the thyroid mesially and exploring the region at the bifurcation of the inferior thyroid artery. Here, as well as at the upper pole and lying rather deep, two normal sized parathyroid glands were found and left in place. No parathyroid tissue was located at the lower pole. The inferior pole vessels were divided, the fascia overlying the gland posteriorly incised and the dissection carried downward into the upper borders of the mediastinum. No tumor was found here, so the same procedure was carried out on the left. Here, however, on deep palpation and lying about 5 cm. below the inferior pole a tumor mass was felt. It was rather easily enucleated and delivered into the operative field. Its vascular attachment was clamped and tied and the tumor removed. It appeared as a firm, grayish-brown, encapsulated mass. Routine thyroidectomy closure was used without drainage.

There was little reaction from the operation and within three days the patient was on a

general diet and seemed to feel somewhat improved. One week following the operation the blood calcium was 6.5 mg. and the blood phosphates 2.6 mg. Blood phosphatase was 10.18 Bodinsky units. She was extremely nervous and apprehensive. Chevostek's and Trousseau's signs were negative. Heavy doses of calcium gluconate and parathormone were administered and during the next few days the patient was much less restless and the blood calcium rose gradually daily until a level of 11 mg. was reached. Blood phosphates rose to 5.5 mg. and remained there.

The fractures, up to the time of operation on the parathyroid, showed no attempt at uniting and there was absolutely no calcium deposit at the seat of fracture. After the operation the fractured areas became gradually more stable, and each month showed more and more callous formation. This process, however, was extremely slow and during the first month following the operation she broke her left clavicle and also the right humerus just by trying to turn herself in bed. It was eighteen months before we attained enough callous union and recovery in the long bones in general to permit the patient to try to walk on crutches.

Two years after operation the patient was readmitted to the hospital for a check up. She was now able to walk quite well on crutches. Blood calcium was 10.5 mg.; blood phosphates were 3.7 mg. She was complaining of a frequency and back ache. The urine contained many pus cells and a few red blood cells. *X*-ray of the kidneys showed the same diffuse calcification as the previous *x*-ray before operation. No isolated calculi were found and the patient improved on routine urinary antiseptics. Electrocardiogram at this time showed no myocardial changes.

Four years after operation the patient was readmitted to the hospital with urinary disturbances. The blood picture was normal in every detail. Urinalysis showed many blood cells and clumps of pus cells and a few granular casts. *X*-ray of kidneys was again the same as before. She responded to treatment but much slower than the previous admission.

Another year passed and she was readmitted to the hospital and presented the picture of a chronic nephritis. Blood urea and urea nitrogen were both elevated, with blood, pus, and casts in the urine. From this she never recovered. She lingered on for another year with periods of remission or improvement. Her blood pressure constantly rose and she gradually showed more and more signs of myocardial failure, and died presenting the picture of cardiorenal disease.

SUMMARY AND COMMENTS

Diagnosis is the most difficult procedure in this affliction when you are confronted with such atypical symptoms and findings. A typical case would naturally have the increase in the blood calcium and the drop in the blood phosphorus and phosphatase. At the same time you should find the bony changes of osteitis fibrosa cystica and the calcinosis of the kidneys with the accompanying urinary findings. Along with this you might have a few of the other systemic findings as loss of weight, impaired appetite, constipation, indigestion, nausea and vomiting, and even pes planus due to muscular weakness.

Many of these cases first present themselves as renal calculi. This case first presented itself with the typical calcium deposits throughout both kidneys of hyperparathyroidism and a resultant urinary finding of pus and blood. The blood calcium remained normal and there were no bony changes for several years. Later she displayed both the bony changes and the increase in the blood calcium but the blood phosphorus always remained rather normal. A very striking thing about the case was the sudden onset of bony changes with the rise in blood calcium. Due to the urinary findings and the kidney *x*-ray findings for such a long period of time without any other changes we were suspicious of tubercular changes. Skin tests and sputum analysis and chest *x*-ray all disproved this theory. I am now of the opinion that when such typical findings in the kidneys are manifested and the other possibilities ruled out that one is justified to explore the parathyroid region for a tumor and not wait for all the other findings and symptoms.

A review of the literature on the subject brings to light many surgical difficulties. One of them is that although you find a

tumor on one side in the parathyroids you should be sure to explore the opposite side for another tumor, which happens quite frequently. Most of them seem to have been found in the upper substernal region but some have been reported posterior to the trachea, at the upper pole of the thyroid, inside the thyroid gland itself, and also at the bifurcation of the inferior thyroid artery. A few cases were reported where the tumor was never found, not even at autopsy. These must undoubtedly be cases in which there is congenitally misplaced parathyroid tissue, such as is found with endometrial tissue as in endometriosis, or a hidden dermoid cyst.

The differential diagnosis relies mainly upon the blood chemistry and *x*-ray. *X*-ray findings might be confused with Paget's disease or osteitis deformans, but the blood chemistry would differentiate the two. The estimation of the hormone quoted in Bodinsky units will range from 12 to 20 in hypercalcemia of hyperparathyroidism, but will be much higher in Paget's disease. In other bony tumors you do not have the hypercalcemia. Rickets is a disease of infants, whereas hyperparathyroidism usually appears between twenty to forty years of age.

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Abbott's Disposable Syringe Set with *Penicillin* in Oil and Wax
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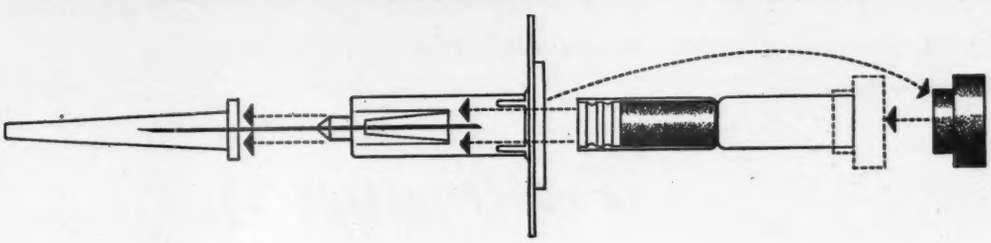

Postoperative distention and urinary retention may occur despite the most skilful surgical technic. Fortunately, the severe distress of "gas pains," discomfort of catheterization, and the need for enemas and symptomatic therapy may be obviated—and the patient afforded a smoother convalescence—by parenteral administration of one ampul (1 cc) of Prostigmin Methylsulfate* 1:4000 at the time of operation, repeated at 2-hour intervals for a total of 6 injections. Recognition of this fact by leading surgeons has made the prophylactic use of Prostigmin a routine measure in many hospitals.

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1. Lehr, D.: Proc. Soc. Exper. Biol. & Med. **58**:11, 1945.
2. Lehr, D.: In press.

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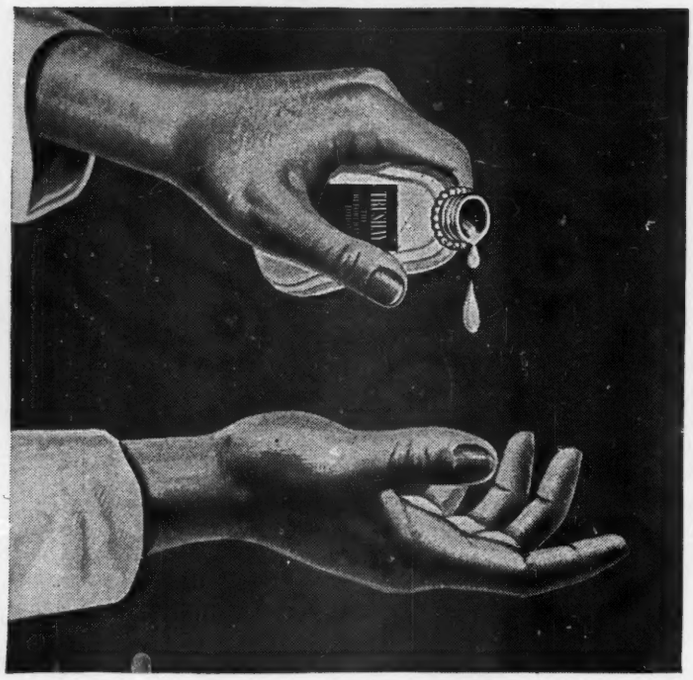

When Used **Before** Washing Hands

There's nothing like a good scrubbing with soap and water to make hands hygienically clean before examining and treating patients.

But if, after washing, a cream or lotion is applied to the hands to prevent redness or roughness, some of the hygienic value of soap and water cleansing undoubtedly is lost.

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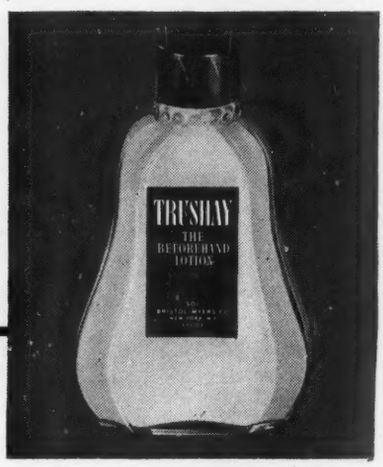
TRUSHAY helps prevent depletion of the skin's natural lubricant . . . aids in keeping the dermal tissue normal and unbroken.

And since TRUSHAY is applied *before* washing, hands can be soft, smooth and well-groomed and still meet the requirements of modern hygiene.



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B-D ACE ADHESIVE No. 10

ELASTIC and ADHESIVE

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Improved B-D Ace Adhesive has long shelf-life. It withstands the standard one-week baking test without impairment to adhesive or other qualities.

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An antiseptic, resinous liquid compound of adherent qualities. Originally devised for skin traction, it is now widely used for many other purposes. Useful for improving the tenacity of adhesive tapes on the skin, for holding dry bandages in place, for traction, and on the hands as an aid to manipulation. Available in 4 oz. bottles, through your regular dealer.

A sample of Ace Adherent will be mailed on request.

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BECTON, DICKINSON & CO., RUTHERFORD, N. J.

In the Nutritional Build-up for Elective Surgery

The steady decline in postsurgical morbidity and mortality is due in no small measure to a realization of the relationship between the nutritional state and surgical recovery. Adequate stores of liver glycogen, minerals, and certain vitamins, as well as nitrogen balance, enable the patient to withstand much better the trauma of anesthesia and tissue manipulation. Immediate postsurgical recovery is usually more rapid, and ultimate recovery is hastened.

Cereals can make an important contribution to the presurgical dietary. Served with sugar and milk, they provide an abundance of biologically adequate protein, carbohydrate, fat, vitamins, and minerals—the very nutrients needed. They are easily digested, and except those made purposely different through the inclusion of bran, are dependably bland, leaving little or no inert residue. Because of their excellent nutritional composition and wide taste appeal, cereals may well be included in all three meals. They are equally nutritious whether of the ready-to-eat or to-be-cooked variety. The table of composite averages indicates the contribution made by a serving of 1 oz. of cereal (whole grain, enriched, or restored to whole-grain values of thiamine, niacin, and iron), 4 oz. of milk, and 1 teaspoonful of sugar.

Calories	**202**
Protein	**7.1 Gm.**
Fat	**5.0 Gm.**
Carbohydrate	**33 Gm.**
Calcium	**156 mg.**
Phosphorus	**206 mg.**
Iron	**1.6 mg.**
Thiamine	**0.17 mg.**
Riboflavin	**0.24 mg.**
Niacin	**1.4 mg.**

The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

CEREAL INSTITUTE, INC.
135 SOUTH LA SALLE STREET · CHICAGO 3

Hypochromic anemia, by impairing the oxygen-carrying power of the blood, may exert its deleterious influence on every organ of the body. Although hemoglobin depression is often too slight to appear of clinical significance, the end result is frequently a syndrome comprising generalized vague, non-pathognomonic symptoms. The frequently associated anorexia and consequent inadequate food intake, together with impaired digestion, all tend to initiate or accentuate multiple nutritional deficiencies.

Heptuna supplies ferrous sulfate, the most readily available form of iron for hemoglobin synthesis, together with seven essential vitamins and fortified with the B-complex vitamins found in liver and yeast. This combination makes for maximal absorption and utilization of iron, stimulates hemoglobin regeneration, and effectively corrects many of the generalized, systemic disturbances encountered in hypochromic anemia.

J. B. ROERIG & COMPANY • 536 Lake Shore Drive • Chicago 11, Illinois

Each Capsule Contains:	
Ferrous Sulfate U.S.P.	4½ Grains
Vitamin A (Fish-Liver Oil)	5,000 U.S.P. Units
Vitamin D (Tuna-Liver Oil)	500 U.S.P. Units
Vitamin B_1 (Thiamine Hydrochloride)	2 mg.
Vitamin B_2 (Riboflavin)	2 mg.
Vitamin B_6 (Pyridoxine Hydrochloride)	0.1 mg.
Calcium Pantothenate	0.333 mg.
Niacinamide	10 mg.

Together with a Liver Concentrate (Vitamin fraction) derived from 6.5 Gm. fresh liver and dried yeast U.S.P. Not intended for use in the treatment of pernicious anemia.

Heptuna

a ROERIG *Preparation*

NOW PENICILLIN-C.S.C.

CRYSTALLINE SODIUM SALT

★ **No Refrigeration Required**

★ **Pain upon Injection Minimized, Even in High Dosages**

★ **Well Tolerated and Effective Subcutaneously**

★ **Potency Clearly Stated on Label**

NOTE THESE ADVANTAGES:

- Since refrigeration is not required, the physician's bag may now contain penicillin in the form of Penicillin-C.S.C. Crystalline Sodium Salt, so that administration may be made immediately at the first call, if indicated.
- Because of its high purity Penicillin-C.S.C. Crystalline Sodium Salt may be given in high dosages.

Available in serum-type vials containing 100,000, 200,000, or 500,000 units

ACCEPTED AMERICAN MEDICAL ASSN.

Penicillin-C.S.C. is accepted by the Council on Pharmacy and Chemistry of the American Medical Association

PHARMACEUTICAL DIVISION

COMMERCIAL SOLVENTS Corporation

17 East 42nd Street New York 17, N. Y.

When Liver Disease Calls for High Protein Intake

For protection of the liver cell against toxic injury, and for safeguarding optimal hepatic function, chief emphasis was placed in the past upon a high carbohydrate diet. This concept worked to the patient's detriment in chronic diseases of the liver, such as cirrhosis, when overemphasis on carbohydrate was combined with protein starvation.

Modern clinical experience has modified the older concept.[1,2] The role of liver glycogen as a protective agent remains unchallenged, but it is now known that the bulk of liver glycogen is combined with protein for mutual stabilization, calling for an ample supply of biologically adequate protein.

Extensive observation in patients with cirrhosis has demonstrated the beneficial influence of a diet high in protein as well as in carbohydrate and B-complex vitamins. Only abundant protein can counteract the associated hypoproteinemia and the ensuing trend toward transudation which further aggravates the hypoproteinemia.

Meat is an excellent source of protein in the diet therapy of hepatic cirrhosis, not only because of the high percentage of protein contained, but especially because its protein is of highest biologic quality. In addition, meat is a good source of vitamins of the B complex.

---

[1] Ravdin, I. S.; Thorogood, E.; Riegel, C.; Peters, Rozanne, and Rhoads, J. E.: *The Prevention of Liver Damage and the Facilitation of Repair in the Liver by Diet,* J.A.M.A. 121:322 (Jan. 30) 1943.

[2] Stare, F. J., and Thorn, G. W.: *Protein Nutrition in Problems of Medical Interest,* J.A.M.A. 127:1120 (April 28) 1945.

The Seal of Acceptance denotes that the nutritional statements made in this advertisement are acceptable to the Council on Foods and Nutrition of the American Medical Association.

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AMERICAN MEAT INSTITUTE

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ALLANTOMIDE—*In major surgery*, a valuable bacteriostatic and healing agent in the management of wounds, compound fractures and burns. *In minor surgery*, an effective aid in the routine treatment of cuts, abrasions and local pyogenic infections.

Whatever the surgical application, Allantomide is of established usefulness in preventing delay in the normal healing process, aiding revascularization of granulation tissue, and guarding against re-infection.

We shall be glad to supply detailed information on the various uses of Allantomide upon request. Address The National Drug Company, Philadelphia 44, Pa.

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PHARMACEUTICALS. BIOLOGICALS. BIOCHEMICALS FOR THE MEDICAL PROFESSION

*"Scarring was considerably less and there were no contractures on the patients treated with the vitamin ointment."**

IN A SERIES OF 713 CASES

- of burns
- trophic, varicose and other chronic ulcerations
- large abscess and carbuncle cavities
- tuberculous ulcerations and sinuses
- frostbites
- x-ray burns
- donor and recipient skin grafting sites

treated with cod liver oil ointment, Daughtry* reports highly satisfactory results.

*DAUGHTRY, DEWITT C.: Cod-Liver Oil Ointment in Surgery, Surgery, *18*:510-515 (Oct.) 1945.

White's Vitamin A and D Ointment was used in the treatment of many of these cases.

White's

VITAMIN A AND D OINTMENT

provides the natural vitamins A and D in an appropriate lanolin-petrolatum base, in the ratio as found in cod liver oil.

Promotes healthy granulation and rapid epithelization without destruction of epithelial elements. Inhibits infection.

No [illegible] odor or excessive oiliness; keeps indefinitely at ordinary temperatures.

Supplied in 1.5 oz. tubes; 8 oz. and 16 oz. jars; 5 lb. containers. *Ethically* [illegible] *not advertised to the laity.*

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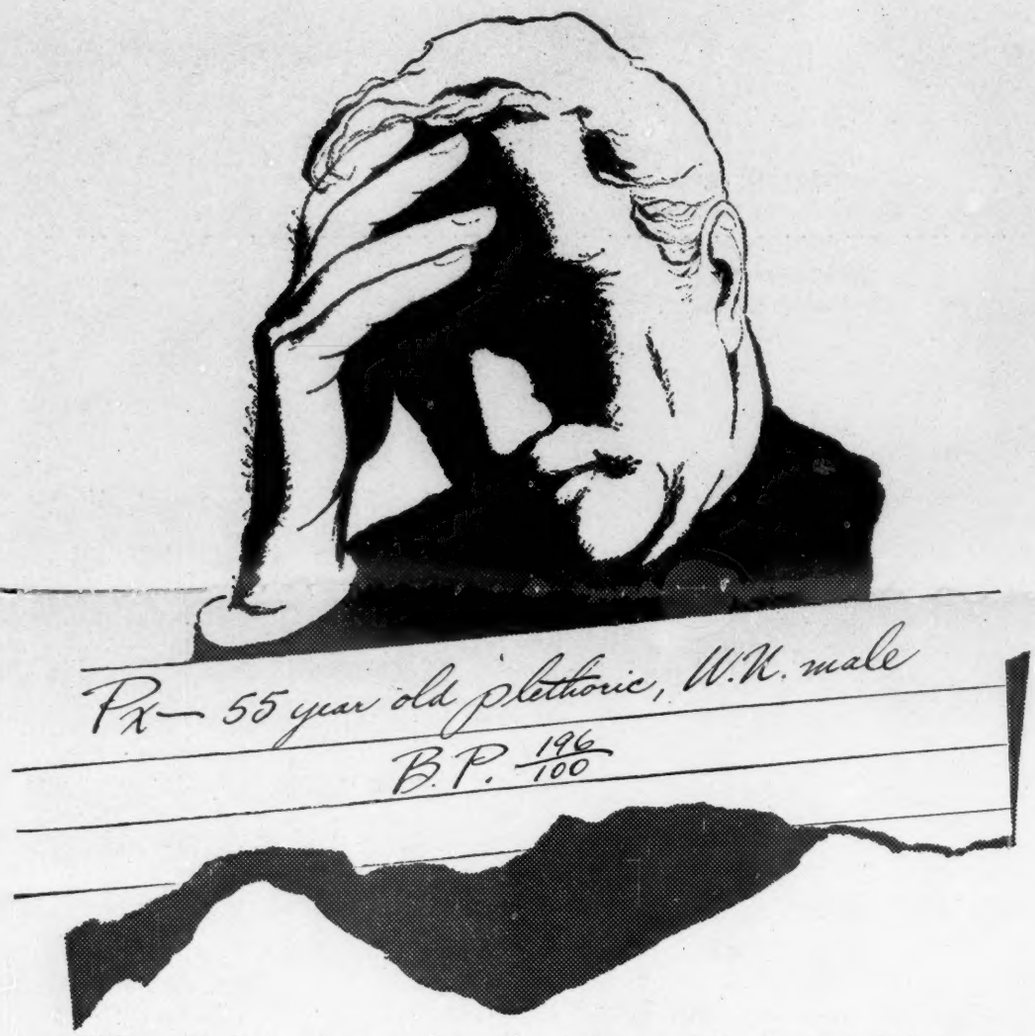

Well nourished? At a glance, yes. But good nutrition cannot be gauged so easily. The hypertensive patient, like the diabetic or peptic ulcer case on a strict regime, may be bordering on nutritive failure *as a result of his special diet.* It takes careful evaluation to determine whether nutritive failure exists.

Spies[1] states: "severe atypical deficiency disease, like other forms of nutritive failure, can be successfully corrected by the application of . . . four essentials." One of these is administration of the four critical water-soluble vitamins in high dosage.

Squibb Basic Formula *is the same formula used by Spies*[1,2] and Jolliffe and Smith[3]—based on years of their clinical experience.

Each Squibb Basic Formula Vitamin Tablet contains: thiamine hydrochloride 10 mg., niacinamide 50 mg., riboflavin 5 mg., ascorbic acid 100 mg.

For complete information, write on your prescription blank "Nutritive Therapy" and mail to Squibb Professional Service Dept., 745 Fifth Avenue, New York 22, N. Y.

Basic Formula SQUIBB

1. Spies, Tom D.; Cogswell, Robert C., and Vilter, Carl: J.A.M.A. (Nov. 18) 1944. Spies, Tom D.: Med. Clin. N. Am. 27:273, 1943. 2. Spies, Tom D.: J.A.M.A. 122:911 (July 31) 1943. 3. Jolliffe, Norman, and Smith, James J.: Med. Clin. N. Am. 27:567 (March) 1943.

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In the severe depressions of the menopause marked by apathy and psychomotor retardation

Many women in the climacteric period develop a true reactive depression, characterized by apathy, psychomotor retardation and despondency.

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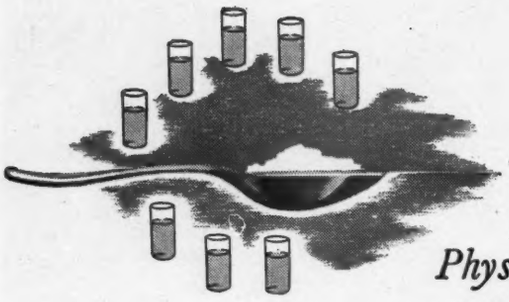
Tablets *Elixir*

(RACEMIC AMPHETAMINE SULFATE, S. K. F.)



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To Break a Laxative Habit

Mucilose—highly concentrated psyllium hemicellulose—provides bland, lubricating bulk . . . stimulates peristalsis physiologically . . . promotes normal habits. The greater effectiveness of smaller doses encourages patients to *stay with* the Mucilose bulk laxative regime.

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For Intestinal Bulk and Lubrication

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INDICATED in spastic and atonic constipation, and as a dietary adjunct for the control of constipation in aged, convalescent and pregnant patients.

DOSAGE: 1 or 2 teaspoonfuls in a glass of any fluid once or twice daily, or may be placed on the tongue and washed down, or eaten with cereals or other foods.

SUPPLIED in 4 oz. bottles and 16 oz. containers. Also available as Mucilose Granules—a dosage form preferred by some patients.

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BY SIMPLE TEAR, THE SHEET IS REMOVED FROM THE TABLE.

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No more laundry bills. No more expense for new linen. Vanco complete $13.50 each. Extra rolls (approximately 300 applications) $3.00 each.

Patented

Write for literature.

Order through your dealer.

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A NEW BOOK SOLVING AN OLD PROBLEM

"TREATMENT OF PERITONITIS *and* ITS AFTERMATH"

—By THOMAS B. NOBLE, JR., M.D., F.I.C.S.

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Complete, 236 pages showing use of plication. 61 illustrations showing step by step, successful control of involved problems. Not a theory but a new, proved control. **$6.50**

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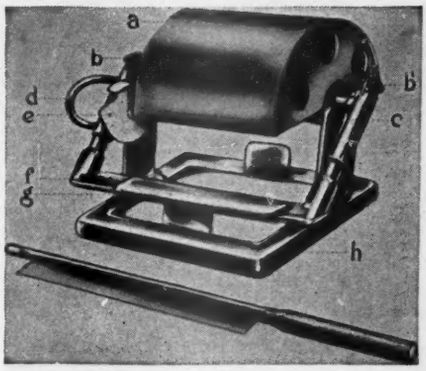
PADGETT-HOOD DERMATOME



By means of this unique instrument a sheet of skin of uniform thickness may be cut at any predetermined level the size of the drum (4 x 8 inches) from any area of the body. Those who have used the dermatome state that it simplifies the technique and enlarges considerably the whole field of skin grafting. Same blade used for drum may be placed in handle and used to cut razor grafts or for honing blade. Rubber cement for the drum and donor area also is available, as well as a knife sharpening service.

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Not affected by Digestive or Tissue Enzymes

Neutral, non-absorbable suture—unusually smooth—uniform in gauge and tensile strength. Action in tissues similar to silk. Stable fibres. Unusual working tensile strength.

Moisture resistant	Splinterless
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Chemically inert	Re-sterilizable

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Aminoids

REG. U. S. PAT. OFF.

A PROTEIN HYDROLYSATE PRODUCT

For Oral Administration

Palatable—has the nut-like flavor of toasted cereal.

Adaptable—may be incorporated in hot or cold fluids, custards, puddings, and other light desserts . . . thus avoiding monotony in administration.

Supplied in bottles containing six ounces.

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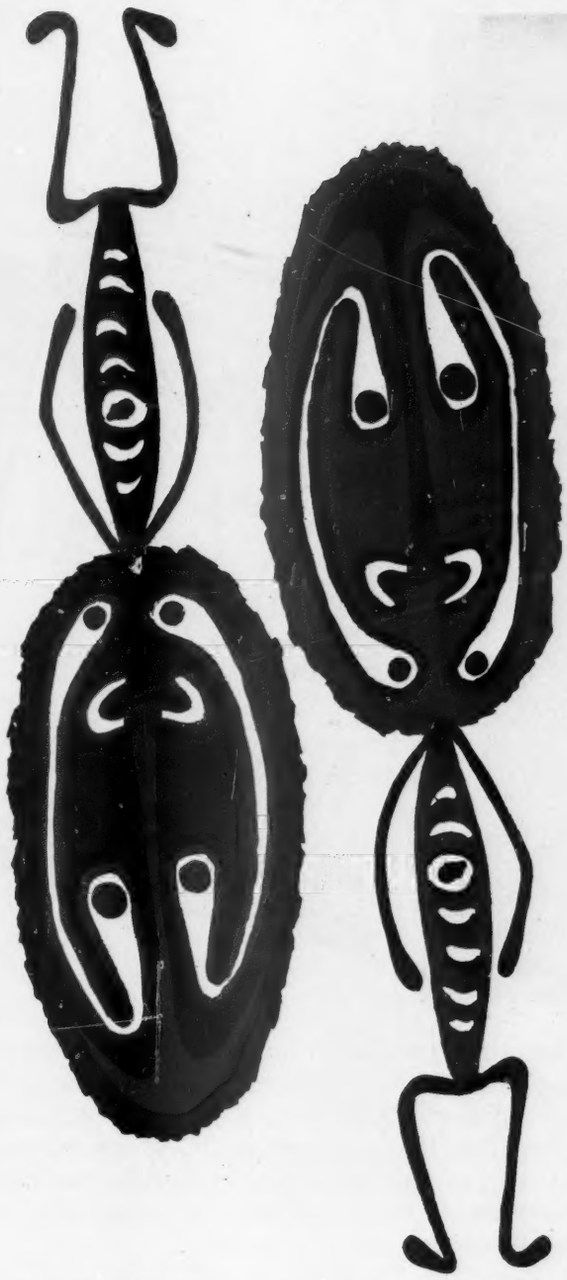

malignancy incognito?

There is *no* danger with 'Anusol'* Hemorrhoidal Suppositories that the symptoms of serious rectal pathology will be masked—for 'Anusol' Hemorrhoidal Suppositories contain no narcotics, no anesthetics. The nerves of the rectal region are not anesthetized, thus permitting continued function of sensory warning mechanisms. 'Anusol' Hemorrhoidal Suppositories achieve relief of symptoms *safely,* by means of decongestion, lubrication and protection.

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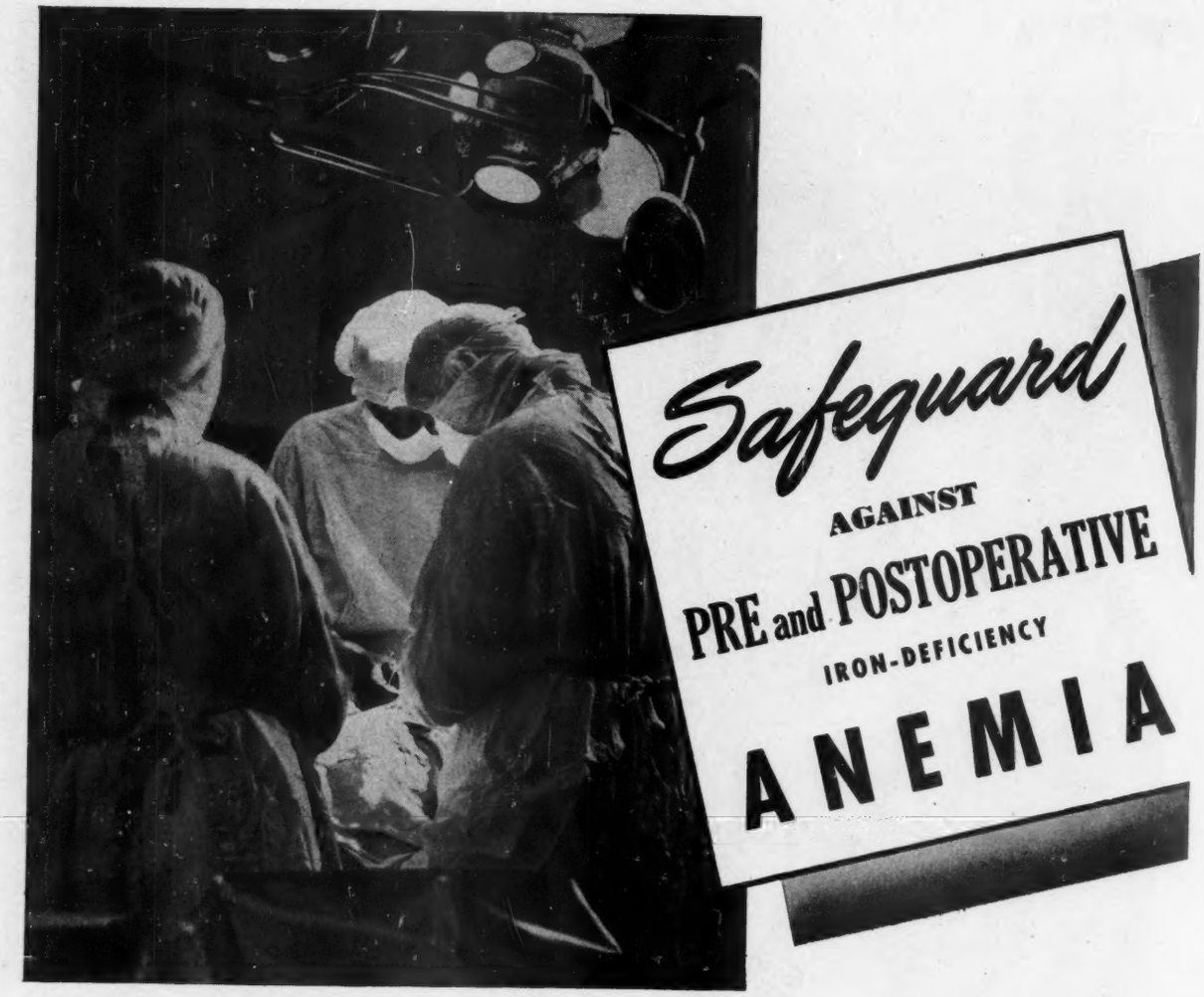

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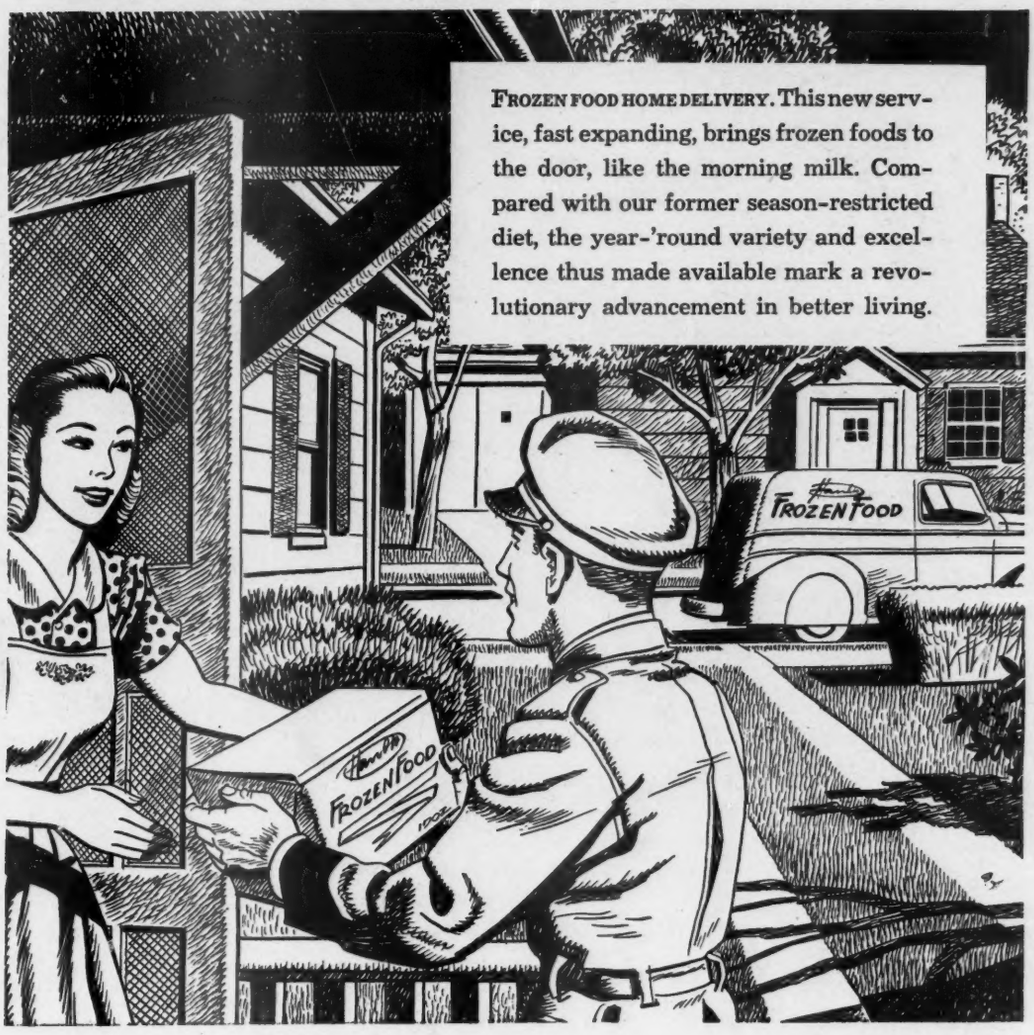

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* Siegler, S.: Fertility in Women, p. 371, 1944

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The American Journal of Surgery

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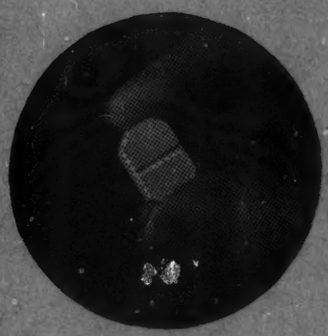

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